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NASA Activities

National
Aeronautics and
Space
Administration

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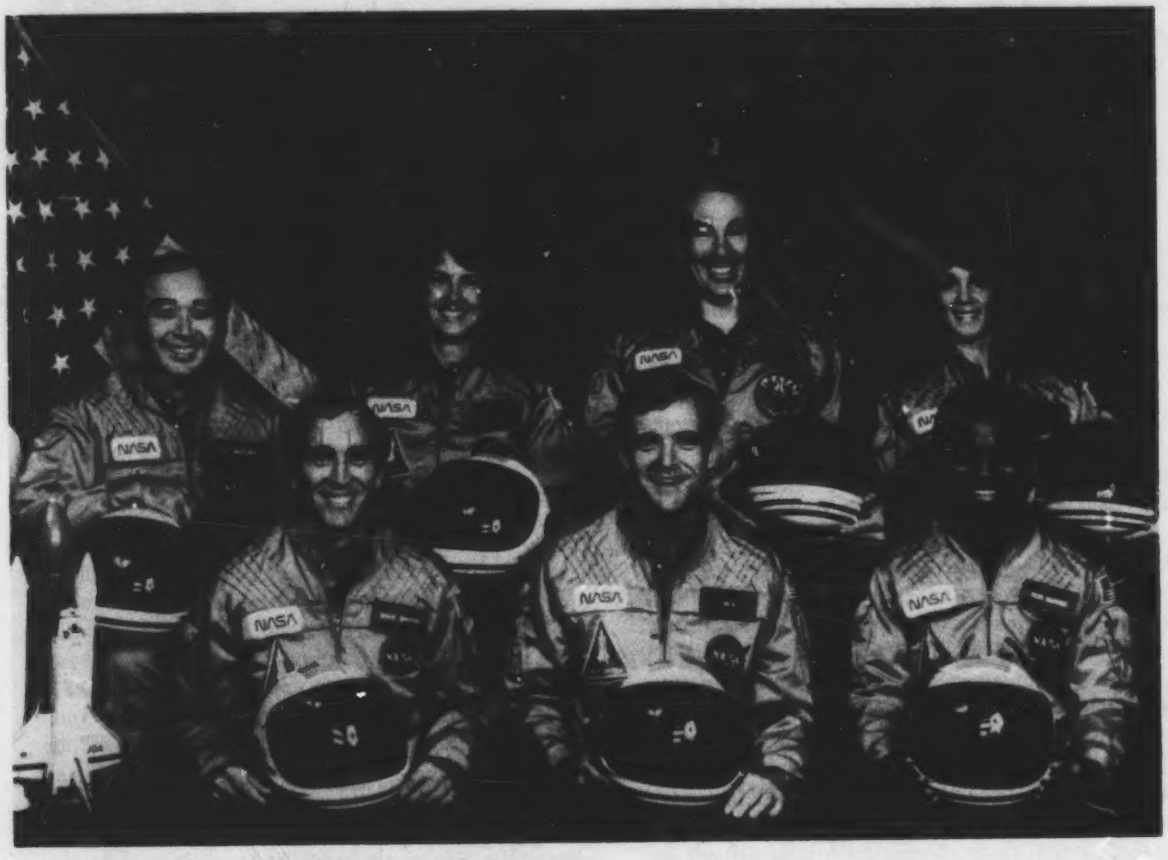
January–February 1986
Vol. 17–[illegible] No. 1 & 2



In Memoriam

NAS 1.46:

About The Cover

On January 28, 1986, at approximately 11:40 a.m. EST, the flight of Space Shuttle Mission 51-L abruptly ended in an explosion.

It is with great sadness that we mourn the passing of these men and women who were members of our NASA family, but it is more important to remember them for their bravery and zest for challenge.

In President Reagan's statement to the Nation, he said, "The crew of the Shuttle Challenger honored us by the manner in which they lived their lives. We will never forget them nor the last time we saw them—this morning—as they prepared for their journey and waved goodbye, and slipped the surly bonds of Earth to touch the face of God."

Contents

Highlights of 1985 NASA Activities 3
Possible Ancient Civilization Uncovered By NASA Technology 8
Heard From Around The World 9
Inside NASA 10
Government Quality Conference 12
Did You Know? 13
Contractor News 14
Major Space Act Awards 15
Another Dividend From Air and Space 16

NASA Activities is published monthly by the National Aeronautics and Space Administration for the information of the agency's employees. Contributions and recommendations are solicited from Headquarters and field centers and should be addressed to Editor, NASA Activities, News and Information Branch, Code LFD-2, Washington, D.C. 20546. Material submitted for publication cannot be returned.

Distributed free of charge only to current agency employees. Available by subscription from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Check or money order should be made payable to Superintendent of Documents, GPO. Subscription rates are $23.00/year, domestic; $28.75/year, foreign.

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Highlights of 1985 NASA Activities

An encounter with the Comet Giacobini-Zinner and nine Space Shuttle missions were among the highlights of the year 1985.

Continuing efforts to develop a permanently manned Space Station were capped in 1985 by awarding contracts to eight industry teams for definition and preliminary design.

NASA began the flight research program of the highly advanced X-29 aircraft in March and the first test flight of the mission adaptive wing was made in October.

Space Flight

The Office of Space Flight had its busiest year ever with nine Space Shuttle flights and three Atlas Centaur and two Scout launches and the last launch of the Aerobee vehicle from all four of the continental launch sites—the Eastern and Western Space and Missile Centers, Wallops Island and White Sands.

The Scout launches, from the Western Space and Missile Center (WSMC), Vandenberg Air Force Base, Calif., and Wallops Flight Facility, Wallops Island, Va., were for the Department of Defense—one for the Air Force and a dual satellite launch from WSMC for the Navy. The Aerobee was launched from White Sands for research purposes and closed the chapter on the use of the Aerobee as a sounding rocket.

The Atlas Centaur launches, all from the Eastern Space and Missile Center, Fla., put Intelsat VA satellites F10, F11 and F12 into synchronous orbit. These satellites will serve the International Telecommunications Satellite Consortia (Intelsat) for up to a decade.

The Space Transportation System's Space Shuttle, along with PAM-D and D-2 upper stages from McDonnell Douglas Corp. and integral upper stages from Hughes, placed 11 communications satellites into synchronous orbit for eight organizations from five countries.

In addition to the communications satellites, the Shuttle carried 11 Getaway Special cannisters during the year. Fifteen middeck or secondary payloads were carried into space and back for organizations as diverse as the 3M Corp. and the IMAX film company. Two Shuttle Student Involvement Project experiments also were flown as were two deployable GAS can satellites. These very small satellites, carried aloft in a GAS can and ejected into space, initiated a new capability in the GAS program.

NASA introduced the last and lightest-weight of the Space Shuttle orbiters—Atlantis. McDonnell Douglas inaugurated their more powerful upper stage booster, the Payload Assist Module D-2.

Shuttle astronauts went outside the confines of the spaceship on three separate missions. On the first spacewalk, astronauts Jeff Hoffman and Dave Griggs attached a "fly swatter" to the robot arm in preparation for a subsequent attempt to activate the dormant Syncom IV-3 (Leasat) satellite. Nearly 5 months later, astronauts Jim van Hoften and Bill Fisher first captured and later repaired the same Syncom in a fascinating "hot wire" in orbit. This latter two-part spacewalk enabled the successful activation of Syncom in November.

The final spacewalk of the year was another two-part exercise with astronauts Sherwood Spring and Jerry Ross. These space-age "iron walkers" proved that human manipulation was alive and well as a possible candidate for Space Station assembly techniques. The separate structures, which these two easily assembled and disassembled, were among the active candidates being considered for Space Station mechanical construction. Spring and Ross not only exhibited the right stuff for orbiting construction jobs, but completed their tasks in record time and under the surveillance of 3-D cameras which will help fine tune the underwater practice runs which have become a precursor to spacewalks.

In all, six Shuttle astronauts spent a total of more than a day in space-suited activities, proving again that one of the Shuttle's most important assets is the human crew on board.

Continuing to carry out its commitment to National Security requirements, the Shuttle flew two dedicated Department of Defense missions, the second of which inaugurated service for Atlantis. In addition to the dedicated DOD missions, the Shuttle flew the first of what are expected to be a series of experiments for the Strategic Defense Initiative program.

Space Science was heavily featured in 1985 Shuttle flights with the NASA Spacelab 3 and, later in the year, Spacelab 2 missions being carried out. These missions flew the first large-scale animal colony (Spacelab 3) and tested the ESA-developed Instrument Pointing System (Spacelab 2). Both the animal colony and the IPS worked although the animal colony was found to need additional refinement before its next use. The IPS adds significantly to the repetoire of Shuttle-Spacelab on-orbit scientific capabilities and is expected to fly about once a year in the future.

The West German D-1 Spacelab mission introduced a new feature of reimbursable Shuttle flights—the scien-

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tific laboratory for hire. This mission was a dedicated scientific flight purchased by the West German government's space research and development organization. Three payload specialists selected by West Germany flew as part of the mission.

In addition to the D-1 payload specialists, two of whom were West German scientists and the other a Dutch scientist, the Air Force flew a payload specialist on each of the dedicated DOD missions; McDonnell Douglas flew their payload specialist, Charles Walker, on two missions; U.S. Senator Jake Garn, one of NASA's subcommittee chairmen, flew as an observer; a scientist from EG&G Corp. and another from the Jet Propulsion Laboratory, flew as part of the Spacelab 3 mission; payload specialists from Saudi Arabia and France flew together during one of the year's busiest missions; scientists from Lockheed Palo Alto Research Laboratory and the Naval Research Laboratory flew as part of the Spacelab 2 mission; and a scientist from Mexico flew to perform experiments as part of the last crew of the year.

All told, 52 individuals flew aboard Shuttles in 1985. Of this group, 19 were scientists performing observations, experiments or investigations; 27 were U.S. military officers (16 Air Force, 5 Navy, 4 Marine Corps and 2 Army) and six were payload specialists from foreign countries (Mexico, Saudi Arabia, France, the Netherlands and two from West Germany).

Four individuals, three NASA astronauts (Bobko, Buchli and Nagel) and one payload specialist (Walker) flew twice in 1985. Although none of them flew both times with each other, Bobko and Walker and Buchli and Nagel flew once with each other.

The combined time spent in space by the 52 individuals was nearly 55 days, or over 88 orbits of the earth for a combined travel distance of nearly 22 million miles.

NASA also selected the teacher to fly in space as part of the citizen participation program. Christa McAuliffe was selected in July to fly in January 1986, and spent the rest of the year in training, along with her backup, Barbara Morgan.

On Dec. 6, NASA turned over to the National Air and Space Museum, the Space Shuttle Enterprise. The Enterprise, an aeronautical and mechanical testbed for the later orbiters, was flown to Washington Dulles International Airport on Nov. 18 from Kennedy Space Center. Eventually the Enterprise will be on view to the general public along with other large aircraft.

Space Science and Applications

Two Spacelab missions aboard the Space Shuttle and an encounter with a comet by the International Cometary Explorer (ICE) highlighted the year for NASA's Office of Space Science and Applications.

The ICE encounter with Comet Giacobinni-Zinner provided valuable information on the makeup and composition of comets. The first spacecraft to ever carry out an in situ investigation of a comet, ICE survived the close encounter and is expected to gain additional information on the make up of Comet Halley in the spring of 1986.

Spacelab 3 was a highly successful "microgravity mission" for the manned laboratory. The seven member crew carried out a highly complex series of crystal growth and fluid mechanics experiments during the seven-day mission. Other experiments included observations of aurora from space, cosmic ray studies and the testing of an animal holding facility.

Astronomy and astrophysics experiments on the Spacelab 2 mission were operated with precision during the Spacelab 2 mission in July. An Instrument Pointing System, developed by the European Space Agency, was operated for the first time and proved it can provide a stable platform for highly sensitive astronomical instruments. Thirteen investigations in 7 scientific disciplines were carried out by the seven-member crew.

The first Spartan mission was conducted when the small versatile system was deployed from the Space Shuttle to study X-ray sources in the Milky Way.

Space Station

On April 19, 1985, a little more than a year since President Reagan directed NASA to develop within a decade a permanently manned Space Station, NASA awarded competitive contracts to eight industry teams for definition and preliminary design (Phase B) of elements of a permanently manned Space Station to be operational in low-Earth orbit by the mid 1990s. The contracts will extend for 21 months and will cover Space Station elements that have been assigned to four NASA centers.

In keeping with a long term policy of international cooperation in space, and the President's invitation to U.S. friends and allies to participate in development of the Space Station, NASA signed memoranda of understanding with Canada, the European Space Agency and Japan. The agreements provide a framework for cooperation during the definition and preliminary design phase of the program. Under the memoranda, the United States and the three international partners will conduct and coordinate simultaneous Phase B studies.

The first formal discussions with the international partners were held at the end of the year to discuss and come to intitial agreement on what Space Station elements each will carry into the preliminary design phase of the Phase B effort. Agreements on elements to be provided by the international partners is anticipated by the spring of 1986 before NASA selects the baseline configuration for Space Station.

NASA also signed a memorandum of understanding with Space Industries Inc., Houston, a privately-funded venture, to exchange information during the Phase B period. SII plans to develop a pressurized laboratory that would be launched by the Shuttle and could be serviced from the Space Station.

During the first half of the 21-month long Phase B period, Space Station designers have been identifying and evaluating alternatives to the reference configuration provided in the request for proposals used by industry to bid on the Phase B contracts. With the aid of potential users from government, scientific, international, commercial and technology groups, a modified version of the "power tower" has been selected as the new reference configuration.

The new layout, the "dual keel" configuration, is rectangular and features two parallel 297-foot tall vertical keels, crossed by a single horizontal beam which supports the solar-powered energy system. In this new configuration, the pressurized modules, which can serve either as laboratories or crew habitats, are placed at the Space Station's center of gravity, the most advantageous spot on the station for experiments that require the best possible microgravity environment. The new configuration provides more space for attaching payloads, and more easily accommodates future growth of the station.

Other decisions made by Space Station designers include:

- ⋆ Altitude of 220 nautical miles for assembly and 250 nm minimum for operations;
- ⋆ Module length of 43.7 ft.; and
- ⋆ Closed environmental control and life support system with only nitrogen to be resupplied.

The Task Force on Scientific Uses of the Space Station conducted a second summer study and is expected to release its report in the spring of 1986. Several international workshops were conducted during 1985 and a new working group was formed to examine respective roles and responsibilities of the foreign partners in the operation of the Space Station.

Two experiments, partially funded by Space Station's advanced development program, flew on Space Shuttle missions in 1985. The first, a capillary pump loop experiment, flew in a Getaway Special canister on Shuttle mission 51-D in April, demonstrating potential thermal control techniques for Space Station components. The second, EASE/ACCESS (Experimental Assembly of Structures in Extra-vehicular Activity/Assembly Concept for Construction of Erectable Space Structures), flown on mission 61-B in November, demonstrated how astronauts could assemble large space structures during space walks. As a result of the flight, engineers have a wealth of data to use in considering methods for future space construction.

Aeronautics

NASA's aeronautical research and technology efforts continued to expand U.S. capabilities in civil and military aviation, contributing significantly to U.S. world aviation leadership and to national security. These efforts covered the spectrum from fundamental disciplinary research to flight testing.

Joint NASA/Department of Defense programs such as the X-29 X-Wing research aircraft, the tilt rotor/JVX aircraft and the convertible engine concept demonstration substantially augmented the military data base; joint NASA/FAA programs addressed lightning strikes, wind shear, icing and other issues affecting aviation safety.

In March, NASA began the flight research program of the highly advanced X-29 aircraft at Ames-Dryden. The X-29A features a unique forward-swept wing, made of composite materials, which offers weight reduction of as much as 20 percent in comparison with conventional aft-swept wings, and forward "canard" wings whose angles relative to the airflow are computer adjusted 40 times a second to improve flight efficiency and aircraft agility.

In October, Ames-Dryden made the first test flight of a mission adaptive wing (MAW) that can change its curvature—the fore to aft curve of the airfoil—in flight for dramatic improvements in aircraft payload, range, maneuverability and fuel efficiency.

Langley's National Transonic Facility (NTF) became fully operational. The NTF is a unique world class wind tunnel using a cryogenic test gas that is capable of simulating and controlling actual flight parameters for advanced aerodynamics research.

The Cray 2 computer, currently the world's fastest and most powerful supercomputer, was installed at Ames. It represents the first major building block in the NASA Numerical Aerodynamics Simulation program, an effort to develop the world's most powerful computational facility for aeronautics research and technology.

Throughout the year tests have been conducted on single-rotation and counter-rotation propfan models in

Lewis' and Langley's wind tunnels to determine high speed performance, flutter and acoustic characteristics. Advanced propellers or propfans can provide jetliner speeds at fuel consumption rates 20-30 percent lower than jet engines.

A new and revolutionary "convertible" gas turbine engine concept was demonstrated successfully early this year at Lewis. This type of propulsion system is necessary for advanced high-speed rotorcraft concepts such as X-wing in which the rotor blades operate in a spinning mode for takeoff and landing and are stopped and locked in place as an X-shaped fixed wing for high speed flight.

A silicon nitride ceramic turbine rotor was successfully operated in automotive gas turbine test bed engine for 30 hours at temperatures up to 1900 F.

Ames' Man-Vehicle Systems Research Facility began operation. Important research into the interface between a pilot and advanced, highly-automated aircraft is being conducted.

A Composite Vertical Stabilizer was flown and certified on KC-10 aircraft.

Langley's Aircraft Landing Dynamics Facility modifications were completed in August to provide an improved capability to study such problems as runway tire traction in adverse weather conditions.

In late 1985, NASA awarded the first phase of a study contract that could lead to the design of a supersonic aircraft with a pivoting wing for increased performance at both subsonic and supersonic speeds.

In April, Dr. G. A. Keyworth II, science advisor to the President, announced three national aeronautics goals:

- ★ Subsonic Goal—Technology for an entirely new generation of fuel-efficient, affordable U.S. aircraft operating in a modernized National Airspace System.
- ★ Supersonics Goals—To develop pacing technologies for sustained supersonic cruise capability for long-distance efficiency above the speed of sound.
- ★ Transatmospheric Goals—To pursue research towards a capability for extremely fast passenger transportation between points on Earth, and also offer a vehicle that could provide routine cruise and maneuvers into and out of the atmosphere with takeoffs and landings from conventional runways.

These goals present substantial challenges for U.S. aeronautics programs which translate to exciting opportunities to NASA research and technology. NASA has used the goals to provide the framework for its aeronautics program planning for 1986 and beyond.

Space Technology

The NASA Space Research and Technology program provides critical, and sometimes unique, elements of the technology base which enables national leadership in space activities. It is focused on technology for the development of more capable, less costly space transportation systems, large space systems such as growth space station, geosynchronous communication platforms, lunar bases and manned planetary missions, and advanced scientific, Earth observation and planetary exploration.

Successful completion of development, assembly and testing of a 15-meter hoop column deployable structure and antenna system was successfully completed at Langley.

Significant changes were made to the Columbia orbiter to accommodate three research experiments to measure orbiter aerodynamic and thermodynamic characteristics as it reenters Earth's atmosphere.

The reactor thermoelectric power system concept was selected by NASA, Department of Energy and Department of Defense for further design, development and ground demonstration testing in Phase II of the SP-100 Space Reactor Power Program.

The ACCESS/EASE experiments conducted on Shuttle mission 61-B were successful. These space construction experiments are enabling the evaluation of ground-based training techniques, in space construction techniques, and productivity in space. ACCESS/EASE laid the ground work for Space Station construction.

Silicon carbide (Nicalon) fibers have been successfully woven in three-dimensional fabrics for the first time for the high temperature thermal Protection System (TPS) applications required by the Orbital Transfer Vehicle and advanced Earth-to-orbit vehicles. This innovative technology will enable lightweight, high strength, reusable TPS structural concepts.

Diagnostic sensors designed to non-intrusively measure the wear/condition of critical life-limiting rocket engine components have been successfully demonstrated in laboratory scale test rigs. These include an isotope wear detector, a fiberoptic deflectometer bearing wear detector, and a turbine temperature sensor (crack detector), based upon the use of a fiberoptic pyrometer device.

Changes in the chemistry and design of nickel-hydrogen batteries have resulted in a six fold increase in the cycle life and show promise of meeting the 50,000 cycle requirement of low-Earth orbit systems. As a result of these advances, nickel-hydrogen batteries are now a prime candidate for energy storage on the Space Station and associated scientific platforms.

A thermal model designed to calculate the temperatures of cryogenic bearing elements under variable operating conditions of speeds, loads, and coolant flowrates has been developed for the first time, and is being validated in a unique NASA bearing test facility that simulates actual loads that occur in high pressure cryogenic turbopumps.

A computational code based on a full Navier-Stokes solution of the complete aerobrake flowfield was developed and permitted a detailed study of this phenomena.

Tracking and Data

Space Tracking and Data Systems provided tracking, command, telemetry and data acquisition support for NASA missions in science, applications, space transportation and aeronautics. These tracking and data systems are transitioning from the traditional ground network station support of low Earth-orbiting spacecraft to the new mode with the successful implementation of the first Tracking and Data Relay Satellite in geosynchronous orbit.

In March, the launch of TDRS-B was deferred as a result of a problem in the timing circuit of the spacecraft. Investigations of these problems and necessary modifications to the spacecraft were completed.

TDRS-2 and 3 are currently scheduled to be launched in January and July 1986, respectively.

The consolidation of the Deep Space Network (DSN) was completed on schedule in February. The DSN provided vital tracking and telemetry support for the Soviet-French balloons which were inflated in the atmosphere of Venus in June, and supported the Giacobini-Zinner comet encounter in September. A major upgrade of the DSN was completed this year. This upgrade enabled the DSN to receive significantly more images from Voyager as it encountered the planet Uranus in January 1986.

Significant accomplishments were completed in the Data System and Communications programs. The Spacelab Data Processing Facility processed and delivered very large volumes of data received from Spacelab-3, Spacelab-2 and the German Spacelab D-1 missions during the year. Development of the Data Capture Facility for the Hubble Space Telescope (HST) was completed, and the Control Center implementation for HST continued on schedule.

A Program Support Communications Network to handle NASA's growing administrative and program management communications needs among its centers also was initiated this year.

Commercial Use of Space

The focal point for NASA's programs for encouraging commercial space activities is the Office of Commercial Programs (OCP). In 1985, the OCP funded and opened the first five of a planned series of Centers for the Commercial Development of Space. These centers are expected to become self-supporting through research collaboration by industry, academia and government agencies.

The OCP currently is overseeing the implementation of 24 agreements between NASA and industries for joint commercial space ventures; negotiating 25 other similar agreements; and seeking access for industries to U.S. government research installations that lend themselves to the development of manufacturing and materials processing in space. The OCP also is expanding NASA's traditional programs which seek to identify NASA-developed technologies that can be adapted and transferred to non-aerospace uses by the private sector.

International Affairs

NASA signed Space Station Phase B Memoranda of Understanding with Canada, Japan and the European Space Agency. These agreements cover the Detailed Definition and Preliminary Design Phase only. Under the memoranda, each side is conducting separate, parallel Phase B studies.

The memoranda established working relationships during Phase B, and provide a mechanism for agreeing on a bilateral basis on what our international partners will be developing for Space Station. Cooperation in the development, operation and utilization phases will be the subject of follow-on agreements with each partner.

NASA continued to launch communication satellites on a reimbursable basis for a number of foreign countries and international organizations. Communication satellites were successfully launched on the Space Shuttle for Australia, Canada, Mexico and the Arab Communication Satellite Organization. Payload specialists representing Arabsat and Mexico were members of the Shuttle crews manning the missions which launched the satellites.

A French payload specialist flew in June in support of cooperative life sciences experiment.

In addition to the Shuttle launches, two communication satellites were launched aboard Atlas Centaur expendable launch vehicles for the International Telecommunications Organization.

The successful 8-day flight of Spacelab 2 at mid-year completed engineering verification of the entire Spacelab system, including the Instrument Pointing System developed by ESA under the cooperative Spacelab agreement.

Reimbursable launch services aboard the Shuttle were also provided for the D-1 Spacelab mission, sponsored by West Germany's Federal Ministry for Research and Technology. This was the first reimbursable launch of the full bay Spacelab which was developed by the European Space Agency as part of the Space Transportation System. The D-1 mission included two German payload specialists and one Dutch payload specialist (representing ESA) among its crew.

Agreements were signed between Chile and the United States providing for the use of Mataveri Airport on Easter Island as a contingency landing site for the Space Shuttle in the unlikely event of an emergency during a launch from the Western Space and Missile Center.

NASA's global geodynamics program continued to expand its network of measurement sites for long-term earthquake research. Agreements were reached with Greece, Turkey and Israel to join the global network of research measurements what already includes Australia, Austria, Brazil, Canada, Chile, China, the Federal Republic of Germany, France, Italy, Japan, Mexico, Netherlands, Peru, Sweden, Switzerland and the United Kingdom. Invitations were extended to 12 countries in the Caribbean, as well as Pakistan and Saudi Arabia.

NASA's Deep Space Network participated in a unique trilateral cooperative activity in June when it tracked French instruments on balloons dropped into the Venusian atmosphere by two Soviet Vega spacecraft, yielding new and exciting data about the winds and atmospheric conditions of Venus.

Final preparations also were made for DSN participation in Pathfinder, a project to significantly improve the targeting of the European Giotto spacecraft during its Halley flyby in March 1986 by tracking the Vega 1 to obtain last minute navigation data.

A NASA primate cardiovascular experiment flew aboard the Soviet Cosmos 1667 biosatellite mission which took place July 10-17. U.S. scientists and engineers are currently participating in post-flight data analysis. NASA has participated in four previous Soviet biosatellite missions—in 1983, 1979, 1977 and 1975.

NASA continued its technical participation with France, Canada and the Soviet Union in the COSPAS/SARSAT satellite search and rescue program. Begun in 1979, the program is in its first year of operational use and has proven its effectiveness in using satellites to detect and relay emergency air and maritime transmission. To date, 510 lives have been saved through this program.

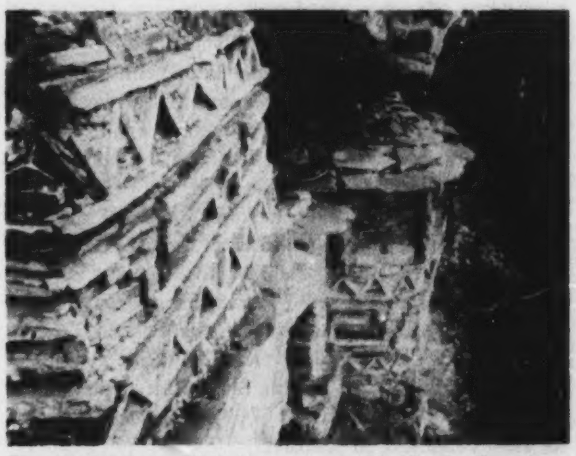
NASA and the Brazilian Space Institute, INPE, jointly conducted the largest research mission to date over the Amazon, The Global Tropospheric Experiment (GTE) Amazon Boundary Layer Experiment (ABLE). GTE/ABLE involved multiple aircraft flights over the Amazon in conjunction with ground truth observations for long-term atmospheric research.

The United States, Federal Republic of Germany and United Kingdom continued work with the Active Magnetospheric Particle Tracer Explorers (AMPTE). Data from the AMPTE mission is now being analyzed.

Possible Ancient Civilization Uncovered By NASA Technology

Using remote sensing technology, NASA's National Space Technology Laboratories (NSTL) and the University of Colorado at Boulder, uncovered information that suggests a civilization existed in the subtropical Peruvian jungles prior to the Incas.

Tom Sever, NASA's principal investigator, and Tom Lennon, archaeologist and co-director of the University's Rio Abiseo National Park Project, jointly completed a 5-day expedition into the jungles of Peru's Rio Abiseo National Park after remote sensing, by satellite and aircraft, permitted the explorers to map and prioritize the field investigation sites.



The ruins found revealed intricate masonry with red and yellow zizag designs.

Prior to the field exploration, Cerro Central, the largest site including more than 250 buildings, was discovered by the remote sensing operation. The ancient site of Gran Pajaten, which included only 30 buildings, previously had been the major point of interest. Sever said, "We know now that Pajaten is probably the smallest and least important of the sites. We are fairly confident that we have approached the very edges of a new civilization and we believe that the farther in we go, the higher and more complicated the elevation of architecture and civilization will be."

Sever said some plant and animal species, thought to be extinct, were discovered. "That is the reason the expertise of more than 30 support people and interdisciplinary scientists was required on the expedition. Lou Whitacker, who climbed Mt. Everest in 1981, was brought in with his team to scale cliffs from which we could see the buildings, but we had no way to reach them."

This closeup of a stone carving was typical of the discoveries. Investigators in the area found that the carved stone heads of figures were set into the walls of structures.

A materials dating process is currently underway to determine when the civilization existed. Sever continued, "Our guess right now is that the civilization was pre-Inca because the architecture is circular and statutary have very delicate motifs, in comparison with the Inca ruins which are long, narrow structures with corner bases. This civilization built a totally different and perhaps more advanced architectural style than has been seen in the Inca civilization." He concluded, "The Inca expanded dramatically in a short time. Apparently, the newly-discovered ruins are from a much more complicated civilization, but they had no desire to expand. Perhaps their empire extended into the Amazon Valley. We are not sure."

NSTL was asked to collaborate in the investigation with the University's Anthropology Department because of the installation's expertise in satellite remote sensing and image analysis.

According to Sever, NSTL remote sensing specialist and archaeologist, the investigation represents the best example of remote sensing application and perhaps the only known means by which the objectives of this project could be obtained. "The job certainly could not be accomplished on foot or by ground survey. We are dependent upon remote sensing because the jungle-cloud-forest environment is treacherous and extensive. Thus, we needed to prioritize where to send the field investigators."

There are more than 1,000 square miles of park to be explored, not only for uncovering valuable archaelogical sites, but also to investigate plant and animal life inhabiting the delicate prestine environment.

Heard From Around The World

India—The India Department of Space has successfully completed third stage rocket motor static firing at SHAR Rocket Launching Station. With this achievement, India has reached another milestone for the launching of augmented satellite vehicles scheduled for March/April of this year.

Austria/Norway—Austria and Norway are to become equal in status to the other eleven members of the European Space Agency. At its 71st meeting, ESA's other member states gave unanimous approval to the granting of full membership status to the two newcomers, who had held associate memberships status since 1981. Austria and Norway have worked closely with the other European states the past 20 years, particularly on the Spacelab, Mares and ERS-1 programs.

Inside NASA

In 1983, NASA's Langley Research Center completed the first major wind tunnel built in the United States in more than a dozen years. Since then, it has been rapidly improving several more of these mighty aerodynamic research facilities.

Almost $20 million is being spent over a two-year period for a variety of significant improvements to three distinctly different wind tunnels. The tunnels' test speeds range from a stiff breeze to nearly 1,000 miles per hour. They test aircraft and aircraft models from subsonic general aviation aircraft to supersonic fighters and everything in between.

Each of the wind tunnels uses giant fan blades to move air or some other gas through a closed circuit, allowing a stationary aircraft model to "fly." The interaction of the roaring wind and these precisely engineered models tell researchers what shape holds the most promise for full-scale flight efficiency, performance or safety—at a fraction of what it would cost to find any other way.

One Langley wind tunnel has been made "heavier" so it can properly test models of lighter and lighter aircraft. It is heavier in the sense that when it started up again this summer for the first time in nearly a year, 50 percent more gas could be pumped into the circuit. This extra density makes an aircraft model feel like it's flying through thicker, heavier air. This makes it easier for researchers to accurately simulate the interaction of models to the aerodynamic forces of rushing wind.

An engineer inspects the cable support system for an F-16 wind tunnel model in Langley's Transonic Dynamics Tunnel.

The giant electric motor that powers the Transonic Dynamics Tunnel has been rewound and improved so that its fan blades still move the wind at sound barrier speeds—even with this extra-dense load to push around. The gas used as a test medium in this continuous flow tunnel is Freon, already four times denser than air. Drive power has been boosted from 20,000 to 30,000 horsepower, and the tunnel cooling, control and power distribution systems have been upgraded to take the extra power.

From a practical standpoint, says Langley's Robert V. Doggett, Jr., "What this means is that now time and money can be saved in making scale aircraft models for tests in the tunnel. Before, with the trend in aircraft design toward lighter and lighter aircraft for more and more structural efficiency, our model builders had to make some models so lightweight that they were difficult to make and easily damaged. The ratio of airplane flight density to model test density is a very important factor for 'aeroelastic' tests like we conduct in the Transonic Dynamics Tunnel.

"Now, with a 'heavier' test medium, our model makers will be making slightly heavier models. This means less balsa wood and styrofoam and more metal. In addition to substantial cost savings, some aircraft models which previously could not be accurately scaled for this tunnel can now be made for the first time."

As an aircraft flies through the air, its wings and tail vibrate at certain frequencies, a harmless combination of structural response to aerodynamic pressures. Most every aircraft is susceptible—at certain speeds—to a potentially harmful interplay of those wing vibrations and aerodynamic forces called flutter. In the most severe cases, unchecked flutter can damage or destroy a wing. Wind tunnel tests can identify a potential flutter problem, and adjustments can be made to the airplane so it is perfectly safe to fly.

The Langley Transonic Dynamics Tunnel is dedicated to aeroelasticity studies and tests and has special features which make it a national resource for flutter and buffet tests.

Its increased density capability is needed chiefly to assure that new designs of high-speed aircraft and space vehicles are flutter free. Work will continue in rotorcraft and active controls research, in ground-wind loads tests of advanced space launch vehicles, and for confirmation of unsteady transonic flow theory. Because of its capabilities and special features, the tunnel usually has a two-year backlog of work. Among the first tests to take advantage of the tunnel's increased capability is flutter clearance of a Gulfstream II with an experimental advanced turboprop engine mounted on one wing. These sub-scale tests will help clear the way for NASA-sponsored flight tests next year.

The Transonic Dynamics Tunnel modification cost approximately $8 million.

Another Langley wind tunnel is being extensively modified to increase tunnel productivity and improve flow quality. The 4- by 7-Meter Tunnel was constructed in 1970 for the study of vertical and short take-off-and-landing aircraft. "V/STOL" aircraft have unique flying characteristics; they also have unique aerodynamic problems. Helicopters, vertical take-off-and-landing jet fighters, and airplanes intended for short runways have all benefitted from the tunnel's model testing.

The 4- by 7-Meter Tunnel has a moving ground plane along the floor of the test section to better simulate flight conditions for takeoff and landing. It also has a removable side wall and ceiling in the test section, allowing a wide range of tests, and a test section size that permits use of large powered models. The tunnel's name, 4- by 7-Meter, defines the test section height and width of 13 by 23 feet. The tunnel has proven its versatility in tests of conventional aircraft as well partly as a result of these features.

The tunnel is increasingly in demand for subsonic aerodynamic research, so productivity is being increased by reducing model changeover time. Improvements to the tunnel's model preparation area will allow parallel preparation of several models, instrumentation calibration and data acquisition checkout before model installation in the test section. Modifications include fabrication of additional model support carts with improved design features, expansion of the model preparation area and new pre-test facilities: a laser velocimeter laboratory and a rotor test cell located near the tunnel test section.

Flow quality—important to accurately simulate a free stream of air—is being improved by a series of seemingly simple changes within the tunnel shell. Flaps have been added to the trailing edge of directional vanes to help the air turn a critical corner without separating into multiple flows; a new and expanded system of screens and other special-purpose filters is expected to dramatically reduce flow turbulence, as is a redesign of part of the test section.

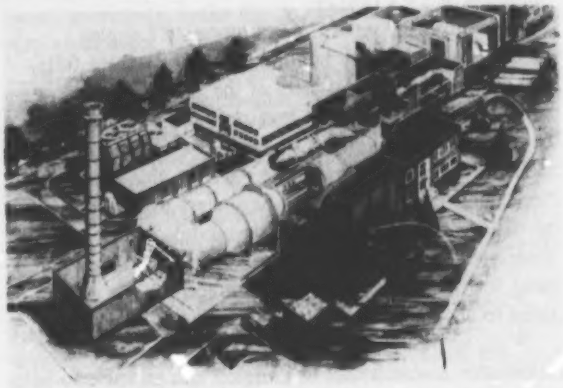
Old thermal insulation in the test section is being replaced with dual-purpose acoustic insulation to improve noise measurements of rotor and advanced turboprop systems.

When the "new" 4- by 7-Meter Tunnel resumes operation in late 1985, the first research program to benefit from its several refinements will be an aerodynamic and acoustic study of helicopter main and tail rotor interactions, followed by low-speed tests of the F-18 fighter.

The 4- by 7-Meter Tunnel work will total about $7.2 million.

The granddady of all Langley's 40-some wind tunnels, the 30- by 60-Foot Wind Tunnel, was shut down in September 1985 to complete its second major modification since its construction more than 50 years ago. Work is expected to be complete in mid-1986.

A new test section turntable and model support system head a long list of improvements designed to increase productivity, allowable model weight and accuracy of data.



This artist concept of the Transonic Facility at NASA's Langley Research Center provides a cutaway view of the wind tunnel.

When the "Full-Scale Tunnel," as it was originally named, started operation in the spring of 1931, a full-scale model or an actual aircraft was hoisted up to the cavernous test section; there, it was anchored to struts connected to a balance and scale system below the model. One of the important early discoveries: Drag tests revealed surprisingly large performance penalties from external struts and other exposed items like air scoops and antennas. During World War II, practically every high-performance aircraft used by the United States was checked out in the Full Scale Tunnel. A variety of other vehicles have undergone aerodynamic tests in the large tunnel, including dirigibles, submarines, radar antennas, gliding parachutes and even models of other wind tunnel structures.

Today, the 30- by 60-Foot Tunnel can still test full-scale general aviation airplanes and good-sized models of larger aircraft like supersonic transports; as a result of an earlier modification, it is uniquely equipped for free-flight model tests. The main research of the tunnel is now directed at the study of the low-speed aerodynamics, static and dynamic stability and control, and associated flow characteristics of military, general aviation and commuter aircraft configurations.

As part of the current modification, top speed of the tunnel will be safely restored to the 100 mph-plus range by aerodynamic improvements ahead of its two 35-foot fan blades, which will eliminate a vibration problem. As with the 4- by 7-Meter Tunnel, model set-up time is being greatly reduced. Other modernization features will reduce tunnel operating time per research program by allowing data to be taken at shorter intervals.

No matter what type of airplane or how fast it flies, it must take off and land, and in some cases maneuver, at relatively slow speeds. This is why—even in 1986—this venerable workhorse will be reharnessed.

The 30- by 60-Foot Wind Tunnel modifications are budgeted at $4.4 million.

Incidently, the newest wind tunnel at Langley, mentioned at the very beginning, recently went fully operational with model tests of the Space Shuttle, an advanced energy-efficient transport and an electronic counter-measures version of the Navy's A-6 fighter. Called the National Transonic Facility, this super-cold "cryogenic" tunnel is giving engineers flight simulations so realistic that its tests of scale models can be correlated directly to full-scale aircraft, eliminating the need for time-consuming and less-accurate extrapolations to account for differences in size.

Wind tunnels—old and new—continue to be an invaluable research tool at Langley and promise to help maintain this country's leadership in aeronautics.

Government Quality Conference

On October 29, 1985 NASA and other interested government agencies sponsored a one-day Government Quality Conference at the Department of Labor to explore quality and productivity issues and cases of interest to senior government officials. More than 200 executives from 30 agencies and the Congress attended the unique session. The Conference addressed the quality and productivity aspects of management with an eye toward stimulating government executives into taking action within their own organizations. As David R. Braunstein, Conference Chairman and Director of NASA Productivity Programs explained in his opening remarks, "I am convinced that management approaches, not cultural aspects, make the difference. Quality is dependent upon expectations for high quality and management rewards for high quality. Productivity is dependent on the ability to build enthusiasm and to tap the talents of the federal workforce. Every study has shown that management leadership, not employee resistance, is the key to high quality and productivity."

The keynote speaker, Andrew Stofan, Director of NASA's Lewis Research Center, underscored the Conference theme with his firsthand account of putting productivity into practice. Stofan discussed his experiences at Lewis and recounted how they had been able to change the leadership's outlook and "get the workforce to feel that they were working in a creative new environment." As an example, Lewis' management was led in tackling head on "real" problems at their management retreats; problems that concerned the work climate as opposed to theoretical problems which skirted ongoing organizational issues. This was a big step toward participative management and consensus.

Another impetus toward participative management at Lewis was the establishment of quality circles. Initially planned as a year's pilot program, the initiative evolved into a network with several hundred participants. From the inception of this program, the labor unions supported quality circles and contributed to their management. At the present time, Lewis hopes to take the system a step further and make the transition to a structure which features the work unit as a quality circle. Stofan's goal for Lewis, working closely with the unions, is to ". . . have one great big quality circle of 2,700 people working together."

Stofan was followed by a panel consisting of Carole Dineen, Associate Director of Management, Office of Management and Budget; Constance Horner, Director, Office of Personnel Management; and Brian Usilaner, Associate Director for National Productivity, General Accounting Office. Each of the panel members gave their perspectives on the President's Productivity Improvement Initiatives.

Carole Dineen set the stage by observing that "the history of productivity improvement efforts in both the public and private sector was rather checkered, "and while industry is beginning to face the necessity for change, government, which accounts for 24.6% of the GNP, must be prepared to do the same. The President's initiatives are designed to "nurture a productivity culture in each agency." Agencies would be expected to build productivity into every program, and make it an integral part of everything they do to accomplish the missions.

Constance Horner viewed the role of OPM in the Productivity Program as one of reviewing the incentives plans and other personnel practices that relate to productivity to assure that programs are in place to encourage productivity as well as "to implement training programs that will help federal employees perform tasks that improve productivity." She discussed "performance management" as an important aspect of productivity and insisted that the system must be equitable. Mrs. Horner also expressed her concern about the relationship that has developed over the past few years between the American public and the civil service. "One of my goals for my tenure as OPM Director is to try to diminish this sense of grievance on both sides and encourage some education to encourage the public to understand the valuable work the civil service does."

Brian Usilaner compared studies the GAO made a few years ago of government productivity programs with similar studies they made of top private sector firms. He observed that industry was ahead of Government. They had begun to realize that productivity had to be "a way of life." Government, too, must make productivity "a way of life" or it will become just another program. He noted that to accomplish this, an environmental change must take place by integrating productivity into basic management systems. The Presidential initiatives, with OPM and OMB support, he felt were a good beginning which could put Government on the road toward institutionalizing productivity.

Did You Know?

Thanks to space age technology, students of Indonesia's Eastern Islands University Association, spread over more than 1,600 miles of ocean, are now joined more closely by satellite communications.

A new communications system has helped make the member campuses scarce professors, research findings and library resources more widely available to the rapidly increasing number of students thoughout the region.

A teleconferencing center and an Earth station recently installed in the village of Wawotobi, on the island of Sulawesi, is powered by a solar power system managed by NASA's Lewis Research Center, Cleveland. The Earth station provides the communications link between Wawotobi and Jakarta and other Earth communications satellite system.

The U.S. Agency for International Development (AID) Rural Satellite Project became operational in Indonesia in 1984 through an agreement with the Indonesia Ministry of Education and Culture.

The teleconferencing center, a classroom large enough for 50 people, is equipped with a speaker system, microphones, a telecopier, an electronic blackboard and a computer graphics display.

The system is interactive and can connect with 11 main campus locations of the Eastern Island University Association and a conference room in the offices of the Director General of Higher Education in Jakarta.

Purpose of the teleconferencing system is to demonstrate the use of satellite communications in developing countries. The solar power system shows the feasibility and practicality of solar (photovoltaic) power systems for small earth stations in remote areas.

Diesel electric generators are generally used to power Earth stations in the absence of conventional power lines. However, the high cost of diesel fuel plus the high operation, security, and maintenance costs for diesel generators, make the use of photovoltaic systems very attractive.

The total photovoltaic array capacity to power the Earth station is 1.5 kilowatts. The battery used in conjunction with the array is expected to last about 10 years before replacement is necessary. The photovoltaic array has a life expectancy of more than 20 years.

According to Richard DeLombard, Project Manager at Lewis, "The high cost for diesel-generated electricity along with the small electrical requirement typical of remote areas make photovoltaic systems are modular, they can be tailored to meet the exact electrical requirement much more closely than can diesel generators.

The satellite system provides national communications services to the 5,000 islands inhabited by radio, telephone and telegraph services nationwide.

Prime contractor for the photovoltaic power system is Hughes Aircraft Co., Long Beach, Calif., and their subcontractor in Indonesia is P. T. Elektrindo Nusantara.

NASA and Hughes will provide operations support to provide required repair, maintenance and spare parts through June 1986. After that time, complete responsibility for the system will be turned over to PERUMTAL, the Indonesian national telecommunications authority.

Photovoltaic power systems have been used almost since the beginning of the U.S. space program to generate electricity for onboard spacecraft needs. Photovoltaic cells convert sunlight directly into electricity.

This project completes renewable energy systems programs managed by the Lewis Research Center for the Department of Energy and the U.S. Agency for International Development. Since 1976, Lewis has been responsible for the installation of 71 photovoltaic power systems in 27 countries plus the United States, including Hawaii and Alaska. These systems have provided power for entire villages, for water pumps, grain grinders, lights, vaccine refrigerators, schools, highway signs, forest lookout towers, insect traps, rural dispensaries and the Earth station.

An instrument has been develped by NASA scientists and a Stanford University engineer that may aid in treating bone fractures and bone-weaking diseases, including early diagnosis of osteoporosis which afflicts millions of the elderly.

The instrument, which measures bone mass and stiffness, was developed to help scientists combat the bone loss that may occur during long-term space flight. It will be useful for manned space stations and extended space journeys, such as trips to Mars.

Known as the Bone Stiffness Analyzer, the instrument is based on the idea that the bone behaves as a structural beam. Well developed concepts for testing the stiffness and displacement properties of structural beams can be applied to measuring the same properties of leg and arm bones.

The theory initially was demonstrated by Dr. Donald Young, a physiologist at NASA's Ames Research Center, Mountain View, Calif. Dr. Charles Steele, professor of mechanical engineering at Stanford University, adapted the instrument for clinical application.

After further tests, Young and Steele plan to use the instrument to create an exercise program for maintaining bone strength during the weightless environment associated with extended spaceflight missions when bones tend to atrophy.

NASA selected official names for two planetary missions scheduled for flight in 1988 and 1990. A mission to map the planet Venus, previously known as Venus Radar Mapper, is now called Magellan. The Mars Geoscience/Climatology Orbiter is now named Mars Observer.

The Magellan mission will map the entire surface of planet Venus for the first time, using a synthetic-aperture radar instrument. The radar—which can image the surface despite the cloud cover that enshrouds Venus—will map the surface with subkilometer resolution adequate enough to identify geological processes and provide information that will lead to an improved understanding of the planet's evolution. The spacecraft will orbit the planet about once every 3 hours, coming as close as 250 kilometers from the surface.

The Magellan spacecraft, attached to a Centaur-G upper stage, is scheduled for launch from the Space Shuttle in April 1988 and arrival at Venus in July 1989.

The name selection resulted from a search conducted by the NASA Headquarters Office of Space Science and Applications, aided by the The Planetary Society.

The Mars Observer mission will map the planet Mars to determine the global elemental and mineralogical character of its surface and to investigate the Martian climate, both present and past.

The Observer spacecraft will be adapted from an existing, production-line type of Earth-orbital spacecraft to reduce costs. This mission will be the first in a series of low-cost planetary observer missions using this approach.

Use of the generic Observer name for a series of related space missions is in keeping with the practice established by NASA's Mariner, Pioneer and Explorer series of missions.

Mars Observer is scheduled for launch in August 1990 from the Space Shuttle. It is scheduled to arrive at Mars in August 1991.

The Magellan and Mars Observer projects are managed by the Jet Propulsion Laboratory, Pasadena, Calif., for NASA's Office of Space Science and Applications.

Contractor News

Boeing Aerospace Operations (BAO) of Cocoa Beach, Fla., was selected for award of the Flight Equipment Processing Contract (FEPC) at the Johnson Space Center, Houston. BAO has the Wornick Co. of McAllen, Texas, as a subcontractor.

The 3-year award, with a 2-year priced option, will be for services beginning in January 1986 at an estimated total cost of approximately $76.5 million. The contract also includes provisions for two additional, unpriced 5-year extensions.

JSC will manage the work under a cost-plus incentive/award-fee contract arrangement which includes an incentive fee for sound cost management and an award fee based on performance.

BAO will assume responsibility for receipt, launch preparation and post-launch activities relating to the overall processing of crew-related flight and flight-type equipment required to support the Space Transportation System program. The primary function of the flight equipment is to support the flight crew in its daily operation of the orbiter vehicle. The contractor will process and resupply the individual equipment items in preparation for launch and operate and maintain support equipment required for the successful processing of the equipment. Included are: Extravehicular Mobility Unit (space suit), food and medical systems, communications equipment and other miscellaneous items.

Hamilton Standard Division of United Technologies Corp., Windsor Locks, Conn.; ILC, Dover, Del.; and RCA Service Co., Cherry Hill, N.J., will remain as suppliers for spacesuit equipment and communications equipment.

This selection represents the consolidation, into one contract, of work being performed by 16 firms under 19 contracts.

In addition to BAO, final negotiations were conducted with Hamilton Standard Management Services, Inc. of Houston.

NASA's Lewis Research Center selected **Cortez III,** of Albuquerque, New Mexico for final negotiations leading to award of a cost-plus-award-fee, 5-year contract valued at approximately $45 million for consolidated logistic and administrative support services.

All work will be performed on-site except for an instrument repair facility the contractor will be required to provide locally.

The contract integrates various on-going service contracts and planned new starts into a single, center-wide support service effort. Types of functions the contractor is expected to perform include security, general delivery, vehicle maintenance, administrative, clerical, instrument support, supply services, and related service efforts.

The selection represents a joint effort by NASA Lewis and the Small Business Administration (SBA) to place contracts into SBA's Minority 8(A) Program through formal technical competition. Qualified senior 8(A) firms submitted technical proposals to consolidate the current contracts into a single support effort. Proposals were then evaluated under formal NASA evaluation guidelines.

Fiscal Year 1985
Major Space Act Awards
$1,000 or Greater

Title of Contribution	Contributor(s)	Employer(s)
Cooling Garments	Patricia J. Kirk Dr. Bill A. Williams William E. Elkins	ARC Former ARC Former ARC
Oxygen Post-Treatment of Plastic Surfaces	Theodore J. Wydeven, Jr.	ARC
Gait Analysis Telemetry System	Salvador A. Rositano Richard M. Westbrook Edward P. Luzzi	ARC
Fire Blocking System for Aircraft Seat Cushions	John A. Parker Demetrius A. Kourtides	Former ARC ARC
Advanced Flexible Reusable Surface Insulation	Howard K. Larson Francis J. Pitoniak Daniel B. Leiser Carlos A. Estrella Marnell Smith Howard E. Goldstein Paul M. Sawko	ARC
Portable Synthesized Speech System	Gilbert H. Leibfritz Howard Larson	ARC
Alkali-Metal Silicate Binders and Methods of Manufacturing and Potassium Silicate Coatings	John B. Schutt	GSFC
Method of and System for Classifying Emergency Locating Transmitters and Emergency Position Indicating Radio Beacons	Paul E. Wren	GSFC
Multiprism Collimator	Peter O. Minott	GSFC
Stirling Cycle Cryogenic Cooler	Max G. Gasser Allan Sherman Philip A. Studer Alexander Daniels Michael P. Goldowsky	GSFC North American Philips Corporation
High Voltage Isolation Transformer	Arthur Ruitberg Carroll H. Clatterbuck	GSFC
High Voltage Power Supply	Arthur Ruitberg Kenneth M. Young	GSFC

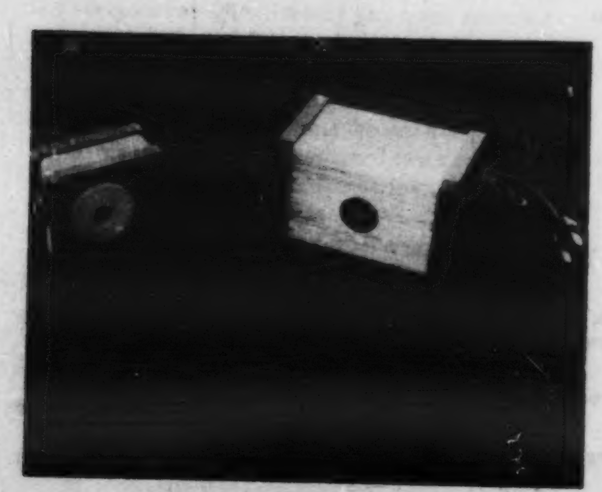
Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans — and at a tiny percentage of the tax dollar. Here is an example:

Visual Alert System

At right, inventor James Campman of Grace Industries, Inc., Transfer, Pennsylvania, is displaying a door installation of the company's Concept I Visual Alerting System (VAS), a multipurpose security device for home or office that combines visual and audible alerts. Intended primarily as a burglar alarm, smoke alarm, door or telephone alert for hearing-impaired people, the VAS is a second-generation spinoff based on electronic circuitry originally developed under contract to Langley Research Center.

The VAS consists of two basic components shown in the lower photo: an audio transponder (white unit) and a companion receiver. Attached to a door, window or telephone, the transponder detects vibrations caused by such noise, as a knock on a door, a break-in attempt, opening of a window or a ringing telephone. The vibrations are converted into a loud beeping tone that is transmitted to the receiver plugged into an electrical outlet. The receiver, in turn, switches on a lamp or causes it to flash. The receiver's sensitive electronic circuitry also detects sounds made by smoke alarms and provides a visual alert. The VAS is designed to deter intruders by the loud beeping noise and additionally to serve as an economical reliable visual signaling device for those unable to hear sonic alerts.



The VAS traces its technological lineage to low noise, low voltage circuitry developed by Applied Cybernetics Systems Inc. For NASA/Langley as part of a telemetry system for relaying spacecraft data to ground station computers.

* U.S. GOVERNMENT PRINTING OFFICE: 1986-491-575-20006

* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

17/3

NASA Activities

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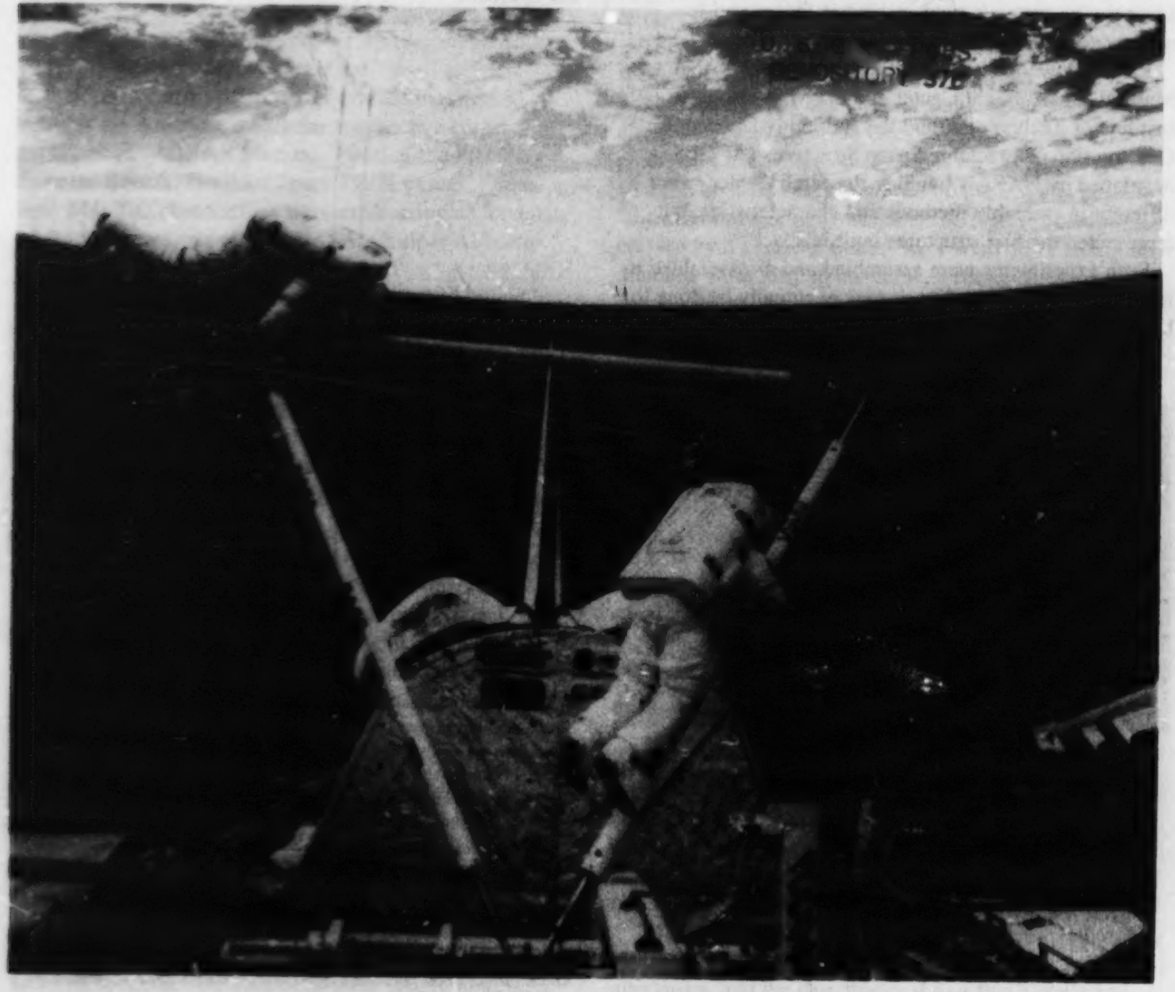

"The NASA can-do spirit is intact . . . we are going to get back on the track of exploring and exploiting space"—Associate Administrator for Space Flight, Rear Admiral Richard H. Truly.

NAS 1.46:

About The Cover

During mission 61-B, launched November 26, 1985, astronauts Jerry Ross and Sherwood Spring assemble the Experimental Assembly Structures in Extravehicular Activity (EASE).

EASE was a geometric structure that looked like an inverted pyramid composed of a few large beams and nodes. Crew members moved about during EASE assemblies, rather than working in fixed positions.

The primary objective of the EASE experiment was to study how people work during space construction and compare the methods used in orbit to those used in underwater training in neutral buoyancy facilities.

EASE, developed in a joint effort between NASA's Marshall Space Flight Center and the Masssachusetts Institute of Technology, and the Assembly Concept for Construction of Erectable Space Structures (ACCESS), developed by NASA's Langley Research Center, were different in assembly methods and characteristics, but represented the first structures built in space.

Both experiments were assembled and disassembled to form larger structures, just as may eventually be done to build the Space Station.

Contents

Scientists Make First Definite Identification Of Water In Comets . 3
NASA Postpones Galileo, Ulysses, Astro-1 Launches 4
Deputy AA For Space Science Named Distinguished Executive .. 5
Remote Sensing Agreement Reached By NASA And ESA 5
United States And United Kingdom Sign Research Agreement ... 6
Engineer Develops Improved Turbulence Model 6
Significant Scientific Results Produced By Spacelab 3 Mission ... 7
Samples Of 51-L Mail From Around The World 8, 9
Dr. Robert W. Brown Named Director Of Educational Affairs ... 10
Interior Designates 22 "Man In Space" National Landmarks 11
From The Congressional Record 13
Contractor News 14
Did You Know? 15
Another Dividend From Air And Space...................... 16

NASA Activities is published monthly by the National Aeronautics and Space Administration for the information of the agency's employees. Contributions and recommendations are solicited from Headquarters and field centers and should be addressed to Editor, NASA Activities, News and Information Branch, Code LFD-2, Washington, D.C. 20546. Material submitted for publication cannot be returned.

Distributed free of charge only to current agency employees. Available by subscription from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Check or money order should be made payable to Superintendent of Documents, GPO. Subscription rates are $23.00/year, domestic; $28.75/year, foreign.

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Scientists Make First Definite Identification Of Water In Comets

A team of NASA and university scientists observing comet Halley in December 1985 have made the first direct confirmation of water in a comet.

The discovery, the first definite detection of neutral water in any comet, lends new support to astronomers' widely held theory that comets are "dirty snowballs" composed primarily of frozen water. The theory was first developed by astronomer Fred Whipple in 1951, but has only received indirect corroboration to date through discoveries of atoms such as oxygen and hydrogen, molecules such as OH and ions such as H_2O+, supposed to be the by-products of underlying ice.

"This was our first direct confirmation that neutral water is the dominant molecular species in a comet," explained Dr. Michael Mumma, Head of the Planetary Systems Branch, Goddard Space Flight Center, Greenbelt, Md. The observations were made using a University of Arizona telescope aboard NASA's Kuiper Airborne Observatory.

The discovery stems from a new theoretical model developed at Goddard by Mumma and Dr. Harold Weaver, now an associate research scientist at the Center for Astrophysical Sciences, Johns Hopkins University, Baltimore, Md. The theory, which Mumma conceived and first presented in March 1980 at a conference on planetary spectroscopy, holds that the parent molecules can best be detected by measuring their infrared fluorescence spectrum stimulated by sunlight.

The theory has been developed extensively since then by the two astrophysicists and has been confirmed by independent work of scientists in France and Japan. It predicts in precise detail the wavelengths and relative intensities of infrared spectral lines emitted by gaseous water and other parent molecules in comets.

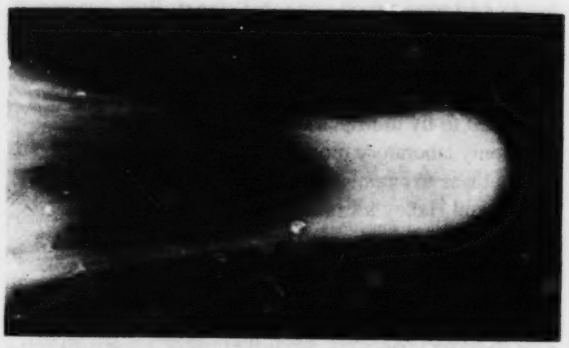
The theory also predicts that a definitive study of cometary water is not possible from conventional ground-based telescopes because of spectral line absorption by water in our own atmosphere.

This problem was minimized by using an airborne telescope and special instrumentation developed at the Lunar and Planetary Laboratory of the University of Arizona by Dr. Harold P. Larson, Dr. D. Scott Davis and Michael Williams. The Arizona group specializes in airborne spectroscopic studies of solar system objects, a program which produced, for example, the detection of water in Jupiter's atmosphere 10 years ago.

The Arizona spectrometer was used to observe comet Halley on the nights of Dec. 21, 22 and 23, 1985. The flying observatory consisted of a 36-inch diameter telescope in a modified C-141 aircraft, operated by NASA's Ames Research Center, Mountain View, Calif. Observations were made at an altitude of 41,000 feet, far above that of any conventional ground-based telescope, to reduce interference by terrestrial water vapor.

Soviet and European spacecraft encountering comet Halley also will be looking for water. "Although NASA did not send a spacecraft through comet Halley, as far as the confirmation of water is concerned, the use of the Kuiper observatory was the most cost-effective way this country could have solved this central problem in cometary science," according to Larson. "This facility and its dedicated staff deserve equal recognition for the success of our project."

The theory accurately predicted the presence of 10 spectral lines of water in Halley's cometary coma, a bright cloud of gas and dust surrounding the cometary nucleus. Observations on Dec. 21 showed four of the 10 predicted lines, while observations on Dec. 23 revealed all 10. The team saw more lines on the last day because "the brightness of the water lines across the board increased by a factor of three," says Weaver. "Finding such dramatic variability in the comet's behavior was a surprise in itself." Comet variability, he notes, has been observed previously by teams observing their atomic composition and brightness.



A view of Halley's Comet from an Earth ground observatory.

Astronomers have been seeking to confirm the presence of water in comets for more than 20 years, first using radio astronomy telescopes and later satellites, such as the International Ultraviolet Explorer (IUE), that observe in the ultraviolet spectrum.

"These attempts largely have failed because water, like most polyatomic molecules, does not fluoresce in the ultraviolet, and the new theory shows that water's radio spectral lines are too weak to be seen," according to Weaver.

The direct detection of a major parent molecule ushers in a new era of direct investigations of the compositions of cometary nuclei and of the physics of cometary coma.

Until now, scientists had to work backward, using the known fragments to infer the identities of plausible parent molecules.

This process was highly uncertain because many potential candidates could have produced the observed fragments, but it was impossible to identify any specific precursor. This discovery demonstrates that astonomers now have a powerful new tool for predicting and detecting, with accuracy, parent molecules in comets including gaseous water and other constituents.

The NASA/university team plans to observe comet Halley again, March 21 through 27 from the Kuiper observatory in Australia, both for water and methane, in an effort to compile the first complete map of a cometary coma for these substances.

NASA Postpones Galileo, Ulysses, Astro-1 Launches

NASA postponed the Ulysses mission to investigate the poles of the sun and the Galileo mission to orbit Jupiter and send a probe into that planet. Both spacecraft were scheduled to be launched by the Space Shuttle in May.

The agency also will not launch the Astro-1 mission, scheduled to fly in March. Astro-1 is an ultraviolet astronomy laboratory mounted in the Shuttle's payload bay that was to examine quasars, "hot" stars, galaxy centers and Halley's Comet.

The decisions on Galileo and Ulysses were made by Dr. William R. Graham, NASA Acting Administrator, after consultations with senior officials of the German Research and Technology Ministry and the European Space Agency. Graham said the decision not to launch in May "does not reflect a judgement that the resumption of Space Shuttle launch operations would necessarily be postponed until after the launch opportunity for either Galileo or Ulysses."

Graham said the decision took into account two principal factors:

"1. Key personnel required to assure a safe and successful launch of either Galileo or Ulysses are preoccupied with the timely analysis of causes of the 51-L accident.

"2. The consequences of the accident have significantly eroded the schedule margins for launch site processing required prior to the first flight of the Shuttle/Centaur upper stage."

An upper stage is a rocket attached to the spacecraft. It is used to boost a spacecraft on its mission from low-Earth orbit after it has been deployed from the Space Shuttle. Two orbiters were modified to carry the missions, Atlantis and Challenger. Challenger was destroyed in the accident on Jan. 28.

Although the missions have been postponed, NASA will proceed with planned tests to ensure that all interfaces between the spacecraft, their upper stages, the Shuttle and the launch facilities are validated prior to launch.

Revised launch dates will be determined after a schedule for resumption of Shuttle launches has been established.

Due to their trajectory requirements, both the Galileo and Ulysses missions are dependent on the relative positions of Jupiter and the Earth at launch time. (Ulysses also must be sent to Jupiter to get a gravity assisted boost to reach the sun). Jupiter must be almost directly on the opposite side of the sun from Earth at the time of launch if it is to be in the required location at the time of spacecraft arrival. This geometric arrangement occurs once every 13 months. Therefore, for a direct launch to Jupiter, both missions would be delayed at least 13 months until another favorable launch window occurred.

This painting shows the Galileo orbiter releasing its atmospheric probe.

Astro-1 had to be launched in the March-April time frame to observe Halley's Comet. With that opportunity gone, a new, specific launch date request for the mission has not yet been established.

However, scientists are anxious to get the mission into space because of the observatory's capabilities. In addition to the unique ultraviolet observations it can make of celestial objects, Astro-1 could complement the observations of the Hubble Space Telescope. It is capable of wide-field observation of the heavens. Scientists would use these observations to select the most interesting targets for detailed investigation by the Space Telescope.

A new launch date will be selected in the future.

Deputy Associate Administrator For Space Science And Applications Named Distinguished Executive

Samuel W. Keller was recognized by the President of the United States in a December 12 ceremony at the Old Executive Office Building with the "Rank of Distinguished Executive". Mr. Keller was cited for his outstanding leadership, meritorious service, personal dedication, technical excellence, and significant contributions of major importance to many of the nation's space flight programs. His creativeness, fairness and consistency, and meticulous attention to major elements of both administrative and technical programs has resulted in a true NASA career of distinction.

In October 1985, at the NASA Headquarters Annual Honor Awards Ceremony, the NASA Administrator awarded to Sam Keller the highest achievement a NASA employee may receive—the NASA Distinguished Service Medal. He was presented the following citation which read: "For providing the highest level of executive leadership in managing the Nation's Civilian Space Science and Applications Programs. Your technical and administrative skills and deep insight into the dynamics of organizational behavior have contributed in a fundamental way to the Agency's long-term capabilities for effective program and project management."

Mr. Keller has been associated with NASA since 1960 when he joined the Goddard Space Flight Center. Subsequent assignments have spanned the management spectrum within the agency. After five years at the Goddard Space Flight Center, Mr. Keller was named Deputy Director for Administration and Management (1965) and, in 1972, was named Director of Administration and Management. In 1975 Mr. Keller transferred to NASA Headquarters as Assistant Administrator for Personnel Programs and was the line official responsible for planning, directing, and managing all aspects of the Agency's programs related to personnel utilization and development. He was then requested by Dr. Frosch, the incoming Administrator, to chair a committee charged with developing a new organizational structure for NASA Headquarters. The intent of this effort was to streamline the decision-making process and reduce the number of organizational elements reporting to the Administrator's office. Evidence that this was accomplished was seen in the 40% reduction in the Administrator's span of control. Major changes were also made in the alignment of Headquarters staff positions. After these organizational concepts were approved, Mr. Keller was appointed Deputy Associate Administrator for Space and Terrestrial Applications. On February 20, 1981, Dr. Calio, the Associate Administrator for Space and Terrestrial Applications, was tasked to an assignment as Acting NASA Deputy Administrator until leaving the Agency in November 1981. During this period, Mr. Keller was charged with the full responsibility for all aspects of the Space and Terrestrial Applications program which had a budget of approximately one-half billion dollars.

In December 1981, Mr. Keller assumed the duties of Deputy Associate Administrator for Space Science and Applications in the newly combined organization, the position he occupies today. Mr. Keller has clearly demonstrated a career of maximum contribution and accomplishment. He has excelled in every assignment and has left behind organizations that are stronger and more efficient as a result of his management expertise and technical competence.

Remote Sensing Agreement Reached By NASA And ESA

Dr. William R. Graham, NASA Acting Administrator, and Professor Reimar Luest, Director General of the European Space Agency (ESA), signed a memorandum of understanding on NASA/ESA cooperation in connection with the first European Remote Sensing Satellite (ERS-1).

Under the memorandum, ESA agreed to permit direct readout of ERS-1 Synthetic Aperture Radar (SAR) data for U.S. government research purposes at the Fairbanks, Alaska, station that NASA is developing in connection with its Navy Remote Ocean Sensing Satellite System, Scatterometer (NROSS) program. In addition to the C-band SAR, ERS-1 will have a C-band scatterometer, radar altimeter, microwave sounder and a precise positioning system.

ERS-1 is planned for launch in 1989 and will have a 3-year projected lifetime with the possibility of a second flight unit to be launched in 1992/93.

Under the agreement, NASA also will exchange its scatterometer and radar imagery for other ERS-1 data of interest. The data received from ERS-1 should enhance

NASA-supported polar ice research and complement NASA experimental activities related to NROSS, the Topography Experiment for Ocean Circulation (TOPEX) and Shuttle Imaging Radar-C, all of which are projected to operate in the same timeframe as ERS-1.

The agreement maintains a tradition of remote sensing collaboration between NASA and ESA for the benefit of the international research and application user community. In permitting NASA direct data readout from ERS-1, ESA reciprocates similar provisions made by NASA for European data readout from the Seasat and Nimbus-7 spacecraft.

United States And United Kingdom Sign Research Agreement

The United States and the United Kingdom signed a memorandum of understanding for a cooperative research program addressing an advanced short takeoff and vertical landing (ASTOVL) aircraft concept.

The memorandum was signed by Dr. William R. Graham, NASA Acting Administrator, and Dr. Donald A. Hicks, Under Secretary for Research and Engineering, Department of Defense, for the United States. Sir David Perry, Chief of Defence Equipment Collaboration, signed for the United Kingdom.

The broad objective of the agreement is to create an environment which encourages collaboration between the United States and United Kingdom governments and their industries to develop technology for ASTOVL aircraft. The aim is to reduce the technological risk associated with potential future ASTOVL combat aircraft. These aircraft will have the capabilities of an advanced supersonic fighter aircraft with the added advantage of landing vertically when necessary.

The research program will investigate four propulsion concepts: vectored thrust, ejector augmentor, tandem fan and remote augmented lift system. The program will assess the relative potential as well as the joint research required for advancement of these technologies to future ASTOVL aircraft.

The two governments envisage the possibility of undertaking a joint experimental aircraft activity that could lead to the production of new generation ASTOVL aircraft, should there be a requirement for such aircraft. Should the joint work be undertaken, it will be covered by separate agreements.

Engineer Develops Improved Turbulence Model

A major breakthrough in turbulence modeling has been reported by engineers at the Marshall Space Flight Center.

While working on developing turbulence models for computational fluid dynamics codes, Dr. Chien-Pin Chen, a National Research Council associate working the the Center's Systems Dynamics Laboratory, developed a multiple-scale turbulence model.

"Turbulence is the random or chaotic motion of liquids or gases that occurs when fluid velocities are high or the physical size of the flow is large," said Chen. Highly turbulent flow occurs inside the Space Shuttle main engine and influences heating, combustion, engine durability, and performance.

According to one of Chen's co-workers, Dr. Warren Campbell, "Turbulence is one of the great unsolved problems of science. Mathematical tools that permit accurate prediction of turbulent flows of liquid or gases are presently not available. This has led to a lot of trial and error based engineering design for fluid handling systems. This is especially true when the designs are revolutionary or push the state of the art."

Dr. Chen reviewing notes on his work.

A classic example of this was the development of rockets, according to Campbell, adding that good mathematical models can reduce the amount of trial and error engineering, or ground testing, which must be done.

"Chen's multiple-scale turbulence model is not the final answer to turbulence modeling," said Campbell, "but it represents a significant advance in the state of the art. For the first time some very complex flows have been accurately predicted."

Chen's method is an extensive revision of an earlier model developed by two widely recognized authorities in the fluid dynamics community—Dr. Brian Launder of the University of Machester Institute of Technology and Dr. K. Hanjalic of the Masinski Fakultet, Sarajevo, Yugoslavia. The earlier model failed to reduce to a simpler form under simple conditions, and the result was a loss of accuracy, according to Chen. With the new model the earlier shortcomings were eliminated.

Chen's model has wide applicability to all types of turbulent flows. The improvement in predictive capability for turbulent flows means reduction in development costs of many high technology products. Those systems for which turbulence plays a major role in manufacture or in performance will be most affected. Examples include advanced propulsion systems like the Space Shuttle main engine, erosion affected structures, and chemical polymerization products. "Also, our understanding of natural phenomena, such as tornado dynamics, and dust effects on atmospheric effects on atmospheric processes will be improved," said Campbell.

"Eventually, the Chen method could result in improvements in the performance of internal combustion engines, including the Shuttle main engine; better designs for dams, canals and other structures where erosion is a problem; longer lasting nonstick coatings of frying pans; and higher quality plastic products."

Significant Scientific Results Produced By Spacelab 3 Mission

Research carried out during the Spacelab 3 mission produced some significant preliminary scientific results, according to mission scientist Dr. George H. Fichtl of the Marshall Space Flight Center in Huntsville, Ala. Researchers and participants in the 7-day Space Shuttle flight gathered at the center to present their initial findings.

"The mission has made some major contributions in the physical and life sciences," said Fichtl of the Center's Systems Dynamics Laboratory. "We have gained a lot of insight for future Spacelab and Space Station research. And I think we can now say that space research is becoming routine."

"Initial results from the three Spacelab 3 crystal growth experiments are very promising," said Fichtl, lead scientist for the Marshall Center-managed research mission. The two tryglycine sulfate crystals and the single mercuric iodide crystal grown aboard the space laboratory were at least as good as the best crystals grown on Earth to date. And they may actually be better, but additional testing will be required to confirm this, according to Fichtl. "This is of major significance, because normally, we must grow between one and two thousand crystals on Earth to get just one crystal that is equal to the quality of those grown on Spacelab 3. Mercuric iodide crystals have application in X-ray detectors, and triglycine sulfate crystals are used in infrared detectors."

Additionally, the methods used to grow the crystals in orbit were proven during the flight. Triglycine sulfate crystals were grown from a solution, as part of an experiment provided by Alabama A&M University in Huntsville. The mercuric iodide crystal was grown using a vapor transport process in an experiment provided by EG&G Energy Measurements Inc. of Goleta, Calif.

The third crystal growth experiment, which also used mercuric iodide and was provided by France, performed as expected and added to scientists' knowledge about the process of crystal nucleation. This is a different process to study on the ground because of gravity-induced convection, according to Fichtl.

The fluid physics experiments also provided new information. The Drop Dynamics Module that was repaired during the flight by principal investigator and payload specialist Dr. Taylor Wang enabled researchers to do some experiments not possible on Earth. Results of the experimentation confirmed some of the theories on how drops behave when rotated. This was the first opportunity to test some theories posed centuries ago by scholars, including Sir Isaac Newton.

The experiment also proved that the use of sound waves is a viable technique for manipulating liquids in a microgravity environment. This has direct application to containerless materials processing in space. This technique allows the processing of materials without incurring the contaminating effects introduced by the container. From the flight, it was learned that the "acoustic bottle" or "crucible of sound" in which the droplet is contained, had much better characteristics than had been theorized. "And this is good news for the containerless processing," said Fichtl.

Drop dynamics experiments confirmed theories on how drops behave when rotated slowly. However, experiment data violated some basic theories relating to the behavior of drops being rotated at higher rates. It was found, for example, that drops tend to transition (change) to a new shape at rotation rates lower than had been predicted. "All this tends to indicate that some of our theories may need to be modified," said Fichtl. The Drop Dynamics Module experiment was developed by the Jet Propulsion Laboratory.

continued on page 10

Messages of Encouragement,Condole

KSC Director Dick Smith told fellow space workers recently, there has been "a great outpouring, not only of sympathy, but also of support from all over the world" in the aftermath of the 51-L tragedy.

The messages have come from friends made by NASA officials' recent visit to China, and from heads of state and individuals around the globe, he noted.

Here are a few samples from that great body of humanity of all ages brought closer by their shared loss.

THE ATRONOMICAL SOCIETY OF SOUTH AUSTRALIA EXTENDS DEEPEST
TO FAMILIES AND FRIENDS OF THE INCREDIBLY BRAVE PEOPLE
THEIR
LIVES IN THE CHALLENGER TRAGEDY. TO ALL AT NASA WE
ENCOURAGEMENT FOR THE CONTINUENCE OF YOUR MAGNIFIC
ACHIEVEMENTS

Febaray 3, 1986.

To N.A.S.A.

In the after math of the Space Shuttle tragedy, I see more polls saying. Should we have more manned spaceflights? I say yes! Nasa should go on and fix the Shuttle. and do greater things in space with men than ever before.

Flint, Mich.

NASA's ground crew
Shuttle O.V.-099 Challenger ✓

As heroes behind the scenes, I wish to tell you that you have been doing a great job of your launches in space shuttle missions and several rockets without a hitch.. I've watched many of these with great interest.

Each mission is special. Each one has something new to explore, maybe a satellite to launch, or a space walk. Each launch holds new experiences and new knowledge for everyone.

Leon, Kansas

Director
John F. Kennedy

Dear Sir;

May I exten
NASA involved in
and most sincere
The adventu
the shuttle this
final rendesvous
it our hopes, ou
Because we are a
ience that is un
program, our shu
must continue. "
pay our fallen h
Thank you f

To everyone at the cape canaveral space center. We are very sad what happened. But we believe in you. carry on the good work and maybe one day I might be able to work for you. God bless you.

age 10

I cried today for once not for myself,
But for the ship and crew of Challenger
And all the people that they knew.

Honolulu, Hawaii

Emsworth
Hampshire
UK

We, because I feel I represent the views of the vast majority of English people, want you to continue with more resolve than ever to continue the manned exploration of space. There is no robot capable of experiencing discovery as man will do, and those that suggest unmanned flight are missing the whole point, its not a technical argument as Discoverer is proving, its about hearts and minds and the ability one day for ordinary people to follow, just as they did Raleigh, Livingstone, Drake and Scott.

They too paid the price, but the mantle of these great explorers resides with you and your team. We know you will continue to carry it with pride and fortitude.

We are behind you 110% of the way, for what its worth.

THE ELLINGTON HIGH SCHOOL CHAPTER OF THE NATIONAL HONOR SOCIETY WISHES TO EXTEND ITS SINCEREST REGRETS ON THE DEATH OF THE SEVEN ASTRONAUTS.

WE WOULD ALSO LIKE TO EXPRESS, AS STUDENTS, OUR DEEPEST APPRECIATION TO ALL THE ASTRONAUTS WHO HAVE, AND WILL AGAIN, RISK THEIR LIVES IN THE PURSUIT OF FURTHERING OUR KNOWLEDGE OF SPACE

ELLINGTON CT

ces Sent To NASA From The Nation, World

ECTICUT

Center

o you, and all those at
r space program, my deepest
mpathy
in each of us was aboard
rning when it made it's
th destiny, taking with
reams and our prayers.
tion blessed with a resil-
ely American, our space
e program in particular,
better tribute can we
n?
your time.

Dear NASA,

As a U.S. citizen, I've had a strong urge to write you on the terrible tragedy of the Challenger Crew on Jan.28th. I was watching from my office as it all was happening and continued to follow all of the news casts afterwards.

I just wanted to say, that even though it was a devastating event and all our hearts went out to the Crew and all their families, I too feel that NASA was not at fault. I try to follow all the space launches and sometimes find myself getting frustrated at all the delays. I know how cautious NASA has been and I feel anger when some try to put the blame on you. I hope the space program will continue in honor of the seven crew members. I know they all looked forward to the flight and would have wanted it to continue.

I for one have not changed my feelings on space travel and if NASA is ever looking to put the first Diabetic in space, please remember my above address and send me an application. Our flag is half staff and everytime I see it I'am reminded of this tragic day. But, if given the chance, I wouldn't hesitate the chance to go.

Please don't cut out civilian space travel. Let us decide if we want the opportunity to see the stars and Earth from space.

KEEP UP THE EXCELLENT WORK!

Neptune, N.J.

1/28/86

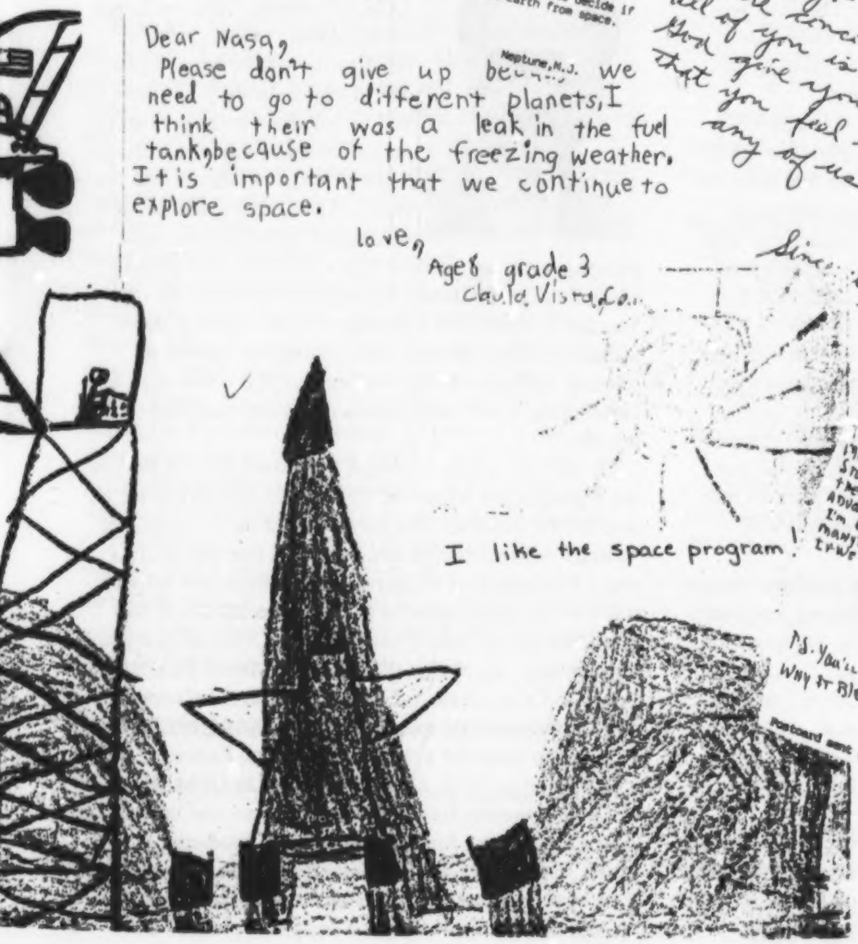
I've been out walking and walking in the snow. I am so devastated and felt I wanted to reach out to you and your colleagues who worked on this mission. My thoughts and prayers go out to you. My sincere concern and pride for all of you is boundless. May God give you strength. I know that you feel this tragedy more any of us

Sincerely,

Springfield, Mass.

Dear Nasa,
Please don't give up because we need to go to different planets, I think their was a leak in the fuel tank, because of the freezing weather. It is important that we continue to explore space.

love,
Age 8 grade 3
Chula Vista, Ca.


I like the space program!

Don't Give up Shuttle
Program, Regardless Of loss
To-Day, You must Go Forward.
Man's Destiny Is to Go to the
Stars to Populate the Planets.
There Will Always be losses In
Advances.
I'm 69 & I've seen the World Turn
Many time and We always have losses,
If We Wish to make things Better.
Don't Give It Up.

1/28/86

P.S. You'll Find the answer
Why it Blew Up.

Postcard sent from Northridge, Calif.

Researchers for the Geophysical Fluid Flow Cell Experiment reported that all 102 hours of their data looked good, and is expected to lead to a better understanding of the dynamics of stellar interiors and planetary atmosphere.

Many of the results confirmed existing theories of convection. It was noted by the research team, however, that at higher heating rates—such as those that may be found on the sun—the date showed some interesting and significant departures from what had been anticipated. Since the mission, researchers have been able to successfully develop computer models of some of this new information.

"In the area of atmospheric research and astronomy, the Atmospheric Trace Molecules Spectroscopy (ATMOS) experiment, sponsored by the Jet Propulsion Laboratory, also produced some fantastic results,' said Fichtl. For the first time, researchers were able to simultaneously measure the concentrations of chemical compounds associated with carbon, nitrogen, oxygen and other chemical cycles in the atmosphere. This will provide a better insight into the chemical processes that govern the distribution of minor and trace gases in the atmosphere between 10 and 100 kilometers.

The instrument worked so well that it was able to record concentrations of gases as low as parts per 100 billion. This is significant, because it is the first time we have been able to make such sensitive measurements, reported Fichtl. And, for the first time, researchers were also able to detect and measure traces of nitrogen pentoxide. This compound had heretofore been undetected in the atmosphere, but was predicted to be present.

The instrument also provided some data that will help researchers understand the gaseous regions above the surface of the sun.

The aurora experiment recorded data on every planned pass, and accumulated 274 color photographs and five hours of video recordings. The spectacular pictures that are still being analyzed have already revealed some structures not previously observed.

The Studies of the Ionization of Solar and Galactic Cosmic Ray Heavy Nuclei (IONS) instrument reportedly worked well, and research teams in India, the sponsoring nation, are still processing their data.

Results from the Research Animal Holding Facility showed that the system worked well overall, and researchers learned a lot about how to operate the facility on future flights. Only minor modifications will be required to the facility.

Researchers concluded that the apparent case of space adaptation syndrome in one of the monkeys supports the contention that this species will be a good model for future studies of vestibular adaptation in microgravity. Researchers reported that both primates are alive and well and residing at the Ames Research Center, the organization responsible for the Research Animal Holding Facility experiments.

Results from studies of the largest group of rats flown aboard a single spacecraft showed their hind muscles were 11 to 36 percent smaller and the bones were less strong after their space flight.

Other researchers are still reviewing their initial data, according to Fichtl.

Dr. Robert W. Brown Named Director, Educational Affairs Division For The Office Of External Relations

Dr. Robert W. Brown has been appointed Director, Educational Affairs Division, Office of External Relations. In this position, Dr. Brown, whose appointment was effective January 13, 1986, will be responsible for providing executive leadership and management of NASA's educational programs. This will include the development and maintenance of effective working relationships with public and private educational communities through such projects as Teacher In Space and Operation Liftoff. Both of these projects are designed to stimulate student interest in science, mathematics and technology and could have a far reaching effect on the nation's educational community.

Dr. Brown comes to NASA from the Office of Personnel Management with over 25 years of federal service in five federal agencies. His career began in 1957 with the Veterans Administration and continued over the next 25 years with positions of increased administrative responsibility in the Department of Health, Education and Welfare's Bureau of Family Services, the Office of Economic Opportunity, the National Institute of Mental Health, the Alcohol, Drug Abuse and Mental Health Administration, and the Office of Personnel Management. In 1977, Dr. Brown was awarded a Brookings Federal Executive Fellowship and in 1979, he was appointed to OPM as Assistant Director for Consulting Services and later, Assistant Director for Performance and Productivity Programs. Dr. Brown was then assigned to the Federal Executive Institute (FEI) in 1982 as Associate Dean for Academic Programs where he designed, planned and scheduled all of FEI's academic programs and provided oversight for educational activities. From January 1985 to the present, Dr. Brown has held the position of Assistant Director for the Office of Finance and Administrative Services, Administration Group, U.S. Office of Personnel Management.

Dr. Brown was born in Kansas City, Missouri. He graduated from Lincoln University in 1956 with a Bachelor of Arts degree in Sociology, a Masters degree in Psychiatric Social Work in 1958 from Atlanta University and a Doctor of Public Administration degree in 1981 from the University of Southern California. Dr. Brown and his wife, Myrtle, live in Rockville, Maryland. They have one son, Gregory.

Interior Designates 22 "Man In Space" National Historic Landmarks

Secretary of the Interior Don Hodel designated 22 properties in Alabama, California, Maryland, Mississippi, New Mexico, Ohio, Texas and Virginia, as national historic landmarks representing the early years of the American space program.

"These designations represent the best, most intact and most important examples of the technology which will interpret for future generations the early years of the American space program," Hodel said.

The Interior Department's National Park Service, as directed by Congress (P.L. 96-344), studied approximately 350 sites associated with the early space explorations for preservation and interpretation. "A Man in Space Theme Study" was initiated to consider resources relating to the following general subthemes: technical foundations before 1958; the effort to land a man on the moon; the exploration of the planets and solar system; and the role of scientific and communications satellites.

The Historic Sites Act of 1935 authorizes the Secretary to designate as national historic landmarks properties identified as having significance to the Nation. National historic landmarks are entered in the National Register of Historic Places upon designation.

Designated National Historic Landmarks

National Advisory Committee for Aeronautics Wind Tunnels

1. Variable Density Tunnel, Langley Research Center, Hampton, Va.
2. Full Scale Tunnel (Langley)
3. Eight-Foot High Speed Tunnel (Langley)
4. Unitary Plan Wind Tunnel, Ames Research Center, Moffett Field, Calif.

These sites represent the technological base of aeronautical research created by the National Advisory Committee for Aeronautics facilities.

Rocket Engine Development Facilities

5. Rocket Engine Test Facility, Lewis Research Center, Cleveland, Ohio
6. Zero-Gravity Research Facility (Lewis)
7. Spacecraft Propulsion Research Facility (Lewis Plum Brook Operations Division)

These represent the important role of the Lewis Research Center in developing hydrogen as a fuel for the Centaur and Saturn V rockets.

Rocket Engine Test Stands

8. Redstone Test Stand, George C. Marshall Space Flight Center, Huntsville, Ala.
9. Propulsion and Structural Test Facility (Marshall)
10. Rocket Propulsion Test Complex, National Space Technology Laboratories, Bay St. Louis, Miss.

These facilities represent the role of the Marshall Space Flight Center in the building and testing of actual space flight rockets.

Rocket Test Facility

11. Saturn V Dynamic Test Stand, George C. Marshall Space Flight Center, Huntsville, Ala.

This facility illustrates another facet of the building and testing and man-rating of the Saturn V Rocket.

Launch Pads

12. Launch Complex 33, White Sands Test Facility, New Mexico

Launch Complex 33 was designated because of its close association with the testing of the V-2 rocket and the origins of the American Rocket Program.

Apollo Training Facilities

13. Lunar Landing Research Facility, Langley Research Center, Hampton, Va.
14. Rendezvous Docking Simulator (Langley)
15. Neutral Buoyancy Space Simulator, George C. Marshall Space Flight Center, Huntsville, Ala.

These facilities were designated because of their association with training programs necesssary to prepare American astronauts to land on the moon.

Apollo Hardware Test Facility

16. Space Environment Simulation Laboratory, Lyndon B. Johnson Space Center, Houston, Texas

This Laboratory is important because it was used to man-rate and test the integrity of the Apollo Command and Service Module, Lunar Module, and spacesuits under simulated space conditions here on Earth.

Unmanned Spacecraft Test Facilities

17. Spacecraft Magnetic Test Facility, Goddard Space Flight Center, Greenbelt, Md.
18. Twenty-Five-Foot Space Simulator, Jet Propulsion Laboratory, Pasadena, Calif.

These facilities illustrate the extensive ground support testing facilities needed to accomplish the American unmanned space program—the exploration of the near and deep space environment.

Tracking Stations

19. Pioneer Deep Space Tracking Station, Goldstone Tracking Station, Calif.

The station was the first antenna to support NASA's unmanned exploration of deep space.

Mission Control Centers

20. Space Flight Operations Facility, Jet Propulsion Laboratory, Pasadena, Calif.
21. Apollo Mission Control, Lyndon B. Johnson Space Center, Houston, Texas

These sites are the very heart and soul of both the American Manned and Unmanned Space Programs.

Other Support Facilities

22. Rogers Dry Lake, Edwards Air Force Base, Edwards, Calif.

Although a natural resource, Rogers Dry Lake was designated because of its association with flight testing of advanced aircraft that opened the way to space.

NASA Nets Meeting

A three-day meeting of the quality circles, NASA Employee Teams (NETS) Coordinators was held at Columbia Lakes Conference Center in West Columbia, Texas on December 10-12, 1985. The meeting was lead by the NASA NETS Program Manager, Dale Crossman, Code N, NASA HQ. A contractor training team from Martin Marietta Michoud assisted. Each center and headquarters were represented by a NET coordinator. Between October, 1984, the end of the pilot period and December, 1985 there was an increase in NETS from 117 to 167—an increase of 43 percent. The NETS exist among all personnel categories—Scientists and Engineers, Clerical, Professional/Administrative, Supervisor/Manager, Technician, Joint NASA/contractor, and contractor on and off site. Anyone interested in forming a NET for group problem-solving sessions should contact their local NET coordinator.

The participants pictured (left to right) are Skip Cole, **LaRC**; William Reynolds, **MSFC**; Ralph Tortorich, Martin Marietta Michoud **(MMM)**; Gene Guerny, **HQ**; Chris Dreyfus, **MMM**; Dale Crossman, **HQ**; Willa Gaitanis, **GSFC**; Mary Kovach, **LeRC**; Mark Rogers, **HQ**; Gene Bishop, **KSC**; Alma Martin, **JSC**; Herman Watts, **NSTL**; Vicki Calbert, **ARC**; Donald Carr, **MMM**; Steve Rohr, **MSFC** and Leo Lunine, **JPL**.

From The Congressional Record

Representative George E. Brown, Jr. provided the following remarks concerning the NASA FY 1987 budget proposal regarding TAV research:

In January, the Space Shuttle *Challenger* embarked on a mission of science and commerce. That mission abruptly ended in tragedy when the vehicle exploded 74 seconds into the flight. America lost seven pioneers that morning. For those millions who watched the tragedy live, or watched it later on tape, the names of the *Challenger* crew will be etched in our memories: Francis R. (Dick) Scobee, Michael J. Smith, Judith A. Resnik, Ronald E. McNair, Ellison S. Onizuka, Gregory B. Jarvis, Christa McAuliffe.

A reassessment of the Space Transportation Systems priorities will undoubtedly take place. My colleagues and I on the Science and Technology Committee will play a large role in that reassessment. Issues will be addressed as to the Shuttle launch priorities once it resumes operations. The Defense Department, for example, had been straining the capacity of the Shuttle even before Tuesday's Shuttle accident, reserving as much as one third of the Shuttle launch capacity. The Strategic Defense Initiative's R&D would put additional demands on the Shuttle capacity through the 1990's. Clearly, with a complement of four Space Shuttles NASA was just able to satisfy the needs of all U.S. customers. The loss of the *Challenger* has resulted in a substantial loss of total launch capacity which will not easily be regained.

To replace the lost orbiter at this point would cost between $1.7 and $2.2 billion, and would take from 3 to 5 years to complete. I personally support funding another orbiter as I have in the past, but other interim steps should be taken as well. For example, it may be cheaper and easier to reinvest in expendable launch vehicles to stem the U.S. launch-capability gap caused by the loss of the *Challenger*. Currently, the Shuttle is only supplemented by four expandable launch vehicles each year. In 4 years or so, the additional shuttle would again be available to handle the increased demand.

This is also an appropriate time to move forward with an advanced next generation Shuttle vehicle. I commend the administration for the farsightedness it has shown by proposing funding for transatmospheric vehicle [TAV] research effort in its fiscal year 1987 budget. NASA and the Department of Defense [DOD] would jointly be charged with researching the vehicle over a 2- to 3-year period. The TAV would achieve speeds of 25 times the speed of sound—Mach 25, the velocity needed to achieve Earth orbit.

The TAV, or National Aerospace Plane [NASP] as the Air Force has officially named it, would potentially drive down the cost of delivery payloads into space by a factor of 100. The flexibility of the hybrid vehicle would allow it to launch on demand and take off and land at major airports. The TAV has also been called the new Orient Express because it will have the ability to travel from the United States to anywhere on the Asian Pacific rim in a matter of a few hours. The possibilities for civilian, as well as defense uses of the aerospace plane are evident.

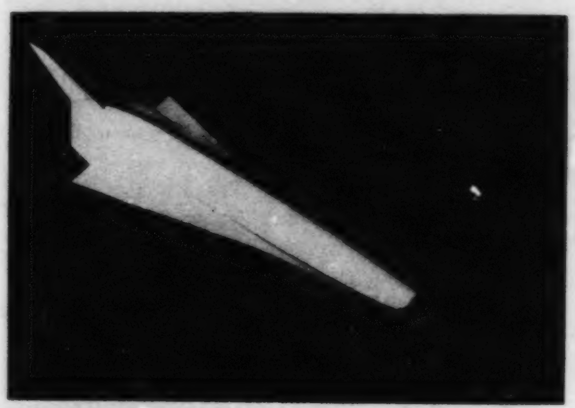
Within DOD, participants include the Air Force, Navy, the Defense Advanced Research Projects Agency [DARPA], and the Strategic Defense Initiative Organization. Funding for the initiative would be split approximately 80 percent and 20 percent between DOD and NASA, respectively. I am concerned that this funding structure is weighted too heavily on the military, but I will hold my reservations in check as long as first, the program remains a basic research initiative, and second, no military mission is imposed on the TAV during the research and development stages.

The proposed TAV requires a $300 to $400 million 2- to 3-year-ground-test program which would concentrate on advancing and demonstrating key engine, materials, and structure technology. NASA requested $42.8 million for the program in fiscal year 1987. Although the DOD contribution is classified, the Washington Post reported that a total of $200 million is requested for fiscal year 1987 activities. If the ground test phase progresses satisfactorily, a test vehicle could be built by the early 1990's for under $2 billion. If Congress will take up the challenge of investing in a TAV program, an operational TAV system could be possible by the year 2000. I fully support moving this program ahead.

Long after the burning issues of this Congress are forgotten, the latter half of the 20th century will be remembered as the era when the people took the first steps off this planet. Long after Gramm-Rudman-Hollings is forgotten, parents will tell their children about the first lunar landing, unmanned expeditions to the planets, and the start of routine travel to space. It is difficult to compare the benefits of the space program to any other federally funded program. How can Congress analyze the "aspirations," measure the "wonderment," or quantify the "hopes" that are the real benefits of America's space program?

Aside from the satellite industry, what we do in space today may not show significant economic gains in the near-term. What we are investing in is a dream—a hope—which may not show material benefit for many years—far beyond the long-term projections of the most liberal economists. I am convinced that people will establish bases on the Moon and Mars, and eventually settle the entire solar system. From those far away colonies, men and women will undoubtedly begin to contemplate manned interstellar exploration. We will do these things because the urge to explore new territories and travel in space is basic to human nature. We cannot deny this ancient desire.

Most major discoveries in the past have been made by individuals who took up the scientific or exploratory challenge on their own. But, today's pioneers can't tinker in their garages and build a vehicle to take them to the stars. Therefore, we, as a nation, must become the curious star voyager and build those ships. As a collective inquisitor, the nation shares in the rewards of the discoveries made aboard ships like the *Challenger*.



A general concept of an Aerospace plane.

The President has asked for sufficient NASA fiscal year 1987 budget, and I would ask that you support a healthy program when it comes to the floor of the House for consideration.

This past year has been plagued with numerous natural and man-inflicted disasters, but none has touched the human spirit more than the explosion of the Space Shuttle *Challenger*. Carrying seven heroes, including America's first teacher in space, the loss will not soon be forgotten. However, the potential gains of exploring and developing space have not diminished with this accident. The hopes and aspirations of the crew of the *Challenger* are still very much a part of the consciousness of America. We must draw from this tragic experience renewed determination to explore space, and to make it a place in which all humans can one day safely travel.

Contractor News

The National Aeronautics and Space Administration signed a memorandum of understanding with **SPACEHAB, Inc.**, Seattle, Wash. The memorandum established a framework for cooperation in SPACEHAB's efforts to develop and market payload bay habitable modules that would augment the pressurized volume of the Space Shuttle.

The SPACEHAB modules would be truncated metal cylinders, 10 ft. long and 13 ft. in diameter, connected to the orbiter crew compartment airlock by tunnel adaptors. The modules would provide additional living and working space for astronauts to conduct experiments in the microgravity environment of space.

NASA and SPACEHAB agreed to enter into negotiations to reach agreement on a number of technical and other issues related to the use of SPACEHAB in the Shuttle. There will be no exchange of funds under the memorandum.

NASA's Marshall Space Flight Center in Huntsville, Ala., selected **Teledyne Brown Engineering** for negotiation leading to the award of a new five-year contract to provide for the operation and maintenance of the propellants and pressurants facilities for the Center. Total price for the first three contract years is approximately $8.8 million.

NASA's Goddard Space Flight Center, Greenbelt, Md., selected **Bell Aerospace Systems Division (BASD)**, Boulder, Colo., for negotiation of a cost-plus-fixed-fee/award contract for the Space Telescope Imaging Spectrograph (STIS).

The contract is for Phase 1 (Definition) of the effort. Approval to proceed with Phases 2 and 3 (Development and Operations) will be contingent upon Goddard Space Flight Center being selected by NASA Headquarters for those phases.

The total proposed estimated cost and fees for the contract for all phases is $40,443,980.

The contract, awarded on February 17, 1986, will cover a period of approximately six and one-half years, from February 17, 1986 through June, 1992.

The contract will provide for the design, fabrication, test and support of the STIS, which is a second-generation Hubble Space Telescope Instrument. The effort will be performed primarily at BASD's facility in Boulder, Colorado, in support of Goddard's Space and Earth Sciences Directorate.

Did You Know?

In December 1985, the International Astronomical Union announced the naming of a minor planet discovered on November 6, 1964, at the Goethe Link Observatory, Indiana University. The planet was named after Dr. Nancy Grace Roman, a space-age astronomer who joined the staff of the National Aeronautics and Space Administration in 1959 and served in the space science area for two decades. Her earlier professional experience included positions at the Yerkes Observatory and the U.S. Naval Research Laboratory.

John K. Lauber, formerly Chief, Aeronautical Human Factors Research Office, Ames Research Center, was recently appointed by President Reagan as a member of the National Transportation Safety Board. Dr. Lauber, with NASA since 1973, has been responsible for internationally recognized research into the causes of human error in aviation. Prior to his departure from NASA, Dr. Lauber was awarded the NASA Medal for Outstanding Leadership for his direction of a large international study of the effects of jet lag on pilots in international air transport.

NASA Lewis Research Center Director Andrew J. Stofan was presented the 1985 Presidential Rank Award to distinguished Executives at the White House on December 12 for his career-long achievements in managing advanced research and technology programs for NASA.

The Westlake, Ohio resident also recived a $20,000 stipend as a result of being selected to receive the Presidential award.

Productivity Meeting Held

A two-day productivity meeting was held by the NASA Senior Executives Committee at Honeywell Inc. in Minneapolis, November 20-21, 1985. The first day was devoted to briefings by Honeywell executives on their productivity improvement and quality enhancement programs, followed by a closed NASA meeting on the second day to review the status of the previous year's productivity programs in the agency. The group made plans and set action items for the initial phase of the NASA Productivity Demonstration Project. The participants pictured are (front row, left to right): Wayne Young, **JSC;** Frank Penaranda, **HQ;** Glen Hogan, **Honeywell Inc.;** Richard Wisniewski, **HQ;** Ray Arnold, **HQ;** Dr. Mary Ann Donahue, **Honeywell;** Gaylord Nickols, **JPL;** C. L. Vignali, **Honeywell;** Fred Povinelli, **HQ;** Dr. Lynwood Randolph, **HQ;** Warren Ahtye, **ARC;** and Feliza Kepler, **Honeywell.** (Second row, left to right): William Kelly, **JSC;** Richard Reeves, **ARC;** Fred Felberg, **JPL;** Russ Ritchie, **HQ;** John Langmead, **GSFC;** Tom Campbell, **HQ;** John Klineberg, **LeRC;** Robert Goetz, **JSC;** Charles Force, **HQ;** Gene Guerny, **HQ;** Jim Coakley, **Honeywell;** B. A. Brock, **Honeywell** and John Heie, **JPL.** (Back row, left to right): Leroy Hopkins, **HQ;** David Braunstein, **HQ;** Lewin Warren, **HQ;** Warren Camp, **KSC;** Woody Bethay, **MSFC;** Joe Malaga, **KSC;** Frank Hoban, **HQ** and Bill Williams, **LaRC.**

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Vehicle Controller

For the Apollo lunar landings of the early 1970s, NASA developed a Lunar Rover to permit exploration of the moon miles from the immediate vicinity of the landing site. The Rover was designed to allow an astronaut to drive one-handed, using an airplane-like joystick to accelerate, brake and steer the vehicle. That technology is being applied to a system that offers severely handicapped people an opportunity to drive highway vehicles, providing them mobility for more productive lives.

Called UNISTIK, the system is being developed by Johnson Engineering Corporation, Boulder, Colorado under the joint sponsorship of NASA and the Veterans Administration Rehabilitation Engineering Research and Development Service, Washington, D.C. The UNISTIK vehicle control system employs a joystick that combines the functions of steering wheel, brake pedal and throttle pedal, thus can be operated by handicapped persons who have no lower limb control and only limited use of upper extremities. The driver simply moves the joystick forward to accelerate, backward to brake and from side to side for steering; any combination of these movements can be used. The UNISTIK control is shown in the lower photo; it is undergoing extensive testing in a Ford van, pictured at right during a demonstration in Washington, D.C.

The UNISTIK system is designed as an addition to an ordinary van. The patented modification utilizes digital electronics, microprocessors and high-torque actuators—one each for brake, throttle and steering—all easily installed entirely under the dashboard as a "bolt-on" accessory. The installation allows full use of the vehicle's normal controls by able-bodied persons; a push of a button switches from regular to UNISTIK control or vice versa. Under way since 1981, the project is now in its final development phase, expected to culminate in production of the system beginning in March.

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* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

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Vol. 17, No. 4

NAS 1. 46:

About The Cover

This is the most detailed artist rendering of the "dual keel" concept of the Space Station being developed. NASA has adopted this modified version of the "power tower" concept as the new reference configuration for the definition and preliminary design phase of the Space Station program. Many of the basic Station designs will be finalized in the next several months. This concept was done by NASA's Johnson Space Center, Houston, Tx.

Contents

Voyager 2 Encounters New Worlds 3
NASA Predicts Revolutionary Advances In Aircraft Performance ... 4
President Awards Ames Chief 1986 National Medal of Science 8
NASA and You 9
NASA Scientists Seek Cause Of East Coast Cyclones 10
NASA Agrees To Canadian Space Station Hardware Proposal 12
NASA Schedules Five Expendable Launches for 1986 12
Heard From Around The World 13
NASA Scientist Awarded International Astronomy Medal 13
NASA To Participate In High Energy Solar Physics Program 13
Contractor News 14
Did You Know? 15
Another Dividend From Air And Space 16

NASA Activities is published monthly by the National Aeronautics and Space Administration for the information of the agency's employees. Contributions and recommendations are solicited from Headquarters and field centers and should be addressed to Editor, NASA Activities, News and Information Branch, Code LFD-2, Washington, D.C. 20546. Material submitted for publication cannot be returned.

Distributed free of charge only to current employees. Available by subscription from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Check or money order should be made payable to Superintendent of Documents, GPO. Subscription rates are $23.00/year, domestic; $28.75/year, foreign.

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Voyager 2 Encounters New Worlds

NASA's scientific ambassador to distant worlds, Voyager 2, unlocked many secrets surrounding the strange planet Uranus in January, as the spacecraft bolted through the Uranian system.

The dependable spacecraft performed almost flawlessly, executing the complicated commands sent by engineers and scientists 1.8 billion miles from Earth. Voyager 2 returned a variety of images and an amazing amount of information that will keep scientists occupied for years.

Voyager 2 surprised scientists with new findings and new objects in the Uranian system, including 10 additional satellites and at least two more dark rings circling the bluish planet.

Uranus is now known to have at least 15 moons and at least 11 rings.

Before the encounter, scientists did not know Uranus' rotation rate, now determined to be once every 17 hours.

Scientists also found high winds in at least three different locations in the atmosphere, winds that travel in the same direction as the planet rotates. Wind speeds increase poleward of the planet's equatorial regions.

"The highest winds we measured were about 130 meters per second, near 40 degrees south latitude," said Dr. Ellis Miner, Assistant Project Scientist. "That is about 300 miles per hour. The lowest winds we detected were around 15 meters per second, which would translate about 35 miles per hour."

Early reports had indicated an unusually high proportion of helium in Uranus' atmosphere. But Voyager 2 detected a normal amount of the inert gas—about 12 percent.

Scientists learned of a high atmospheric haze layer, possibly caused by methane ice. Another form of haze, or what Voyager scientists described as photochemical "smog," was detected at the south pole apparently hiding the clouds below.

"We found a magnetic field at Uranus—strangely tilted 55 degrees with respect to the rotation axis." Miner said. "The field strength at the surface is slightly less than Earth's and slightly more than Saturn's."

Uranus' elusive dark rings revealed several surprises.

"Besides the two new rings found in the imaging data, the photopolarimeter detected 10 possible additional rings. They may be complete rings or perhaps just arcs," he said.

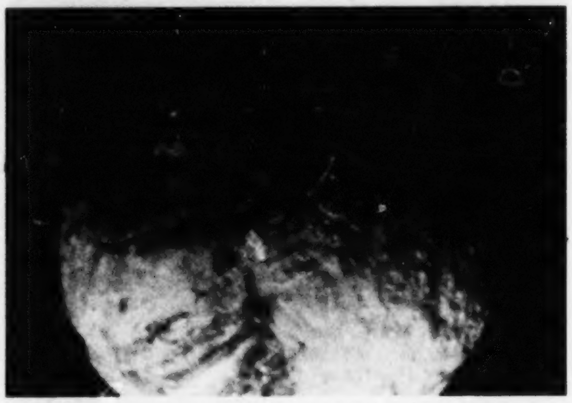
Quite different than the rings of Saturn, Uranus' rings are composed of large boulder-sized particles, with most of the mass contained in chunks three feet or larger. Saturn's rings, by comparison, are composed of bright grain-sized particles.

"This doesn't mean there are no smaller particles in Uranus' rings. We have seen evidence of very diffuse tiny particles extending over most of the known ring system," Miner explained.

The moons of Uranus captured much attention during the encounter. The 10 new moons range in size from 10 miles in diameter to 110 miles in diameter. Voyager team members continue to look for additional moons called "shepherding" moons—that herd particles into rings around the planet. Only two of the new moons can be considered shepherds, flanking the epsilon ring.

Images returned of the five previously known moons—Miranda, Ariel, Umbriel, Titania and Oberon—delighted and mystified scientists. There was a wide variety of surface features on these satellites.

"Miranda is particularly interesting," Miner said.



A Voyager 2 image of Miranda from a distance of 91,000 miles. Note the system of ridges, valleys and impact craters that abuts the terrain.

This tiny moon roughly 300 miles in diameter—is one of the most bizarre worlds in the solar system. It has an astonishing array of geologic features: mountains and valleys, an area of grooved terrain that resembles a race track and other areas with sinuous scarps, probably fault lines. The most predominant feature was a "Y" shaped, or chevron, feature—noticeable long before Voyager 2 made its closest approach to the small sphere. Miranda is also packed with impact craters—implying the once geologically active satellite has been dormant for some time.

Umbriel also puzzled scientists. Sandwiched between the other active satellites, this moon is very dark, very old and seemingly inactive. Its surface is scarred with large impact craters about 60 to 120 miles wide.

Long valleys etch the surface of Ariel, some of them filled with more recent bright-colored material. Titania revealed deep fault lines running across the entire surface of the satellite, in some cases at least 1,000 miles long. Oberon's icy surface boasted a large mountain and hundreds of impact craters surrounded by bright rays. One impact crater contained a bright central peak and a floor partially covered with very dark material.

"For four of the five major moons Ariel, Umbriel, Titania and Oberon we have preliminary density estimates. Those estimates imply that the moons are about 50 percent ice and 50 percent rock," Miner said.

Even at the low light levels present at Uranus, images of the satellites were amazingly clear with no evidence of blurring, this due to painstaking measures taken by the Voyager spacecraft team to reduce imaging smear.

A detailed image of Ariel taken from a distance of about 80,000 miles. Numerous valleys and fault scarps crisscross the highly pitted terrain.

"The spacecraft team and the sequence team went through a Herculean effort to provide us with target-motion compensation for all five of the known moons," Miner said. "The images returned were essentially free of any type of smear."

"The engineers also reprogrammed our flight data computer not only to give us more useful data modes but also to compress the imaging data prior to its transmission to Earth."

The Deep Space Network (DSN) was also instrumental in the mission's success. The DSN just converted to a new hardware and software system and even though not all of the problems had been worked out, almost all of the important data were returned to scientists at NASA's Jet Propulsion Laboratory, Pasadena, Calif.

"It's a source of pride to all of us that things worked as well as they did," Miner said. "I think they worked well because of the Voyager team. They looked for every possibility and designed the observations to be as fault-free as possible.

NASA Predicts Revolutionary Advances In Aircraft Performance

Advances through aeronautical research and technology development have brought aviation to the threshold of a new era in air transport performance, according to a NASA report—an era that could introduce a new generation of aircraft with improvements as important as the introduction of jet transports more than 30 years ago.

The report, prepared by Gerald G. Kayten, NASA Headquarters, Washington, D.C., and Cornelius Driver and Domenic J. Maglieri, NASA's Langley Research Center, Hampton, Va., asserts that the basis for this dramatic development is not a specific breakthrough in any single technology. They say it is an assortment of advances in a wide variety of technical areas. Some of them are quantum jumps, others are relatively minor refinements.

"Most of the separate advances offer sufficient benefits in their own right," say the three authors, "so they will eventually be incorporated to some extent as individual features of derivative or conventional new aircraft. When combined and properly blended together, however, they can become the ingredients of revolutionary new designs with the potential for spectacular improvements in air transportation."

The report says that several example aircraft, based on very preliminary design studies, reveal two additional points:

- New subsonic transport design approaches may feature unusual configurations with important performance and economic advantages that must not be rejected simply because they do not look like today's aircraft.
- Technology benefits applied to supersonic design are so potent and the growing need for highly productive transportation between far-distant population centers is so apparent, that serious reconsideration must be given to a concerted effort to be ready for a new supersonic transport generation.

In spite of severe financial hardships faced by several major airlines and a number of smaller new ones, Kayten, Driver and Maglieri report in "The Revolutionary Impact of Evolving Aeronautical Technologies" that the potential economic benefits of emerging technologies and intensified competition will make new transport developments inevitable. Concern that air traffic may not grow fast enough to pay for these developments is dismissed by quoting forecasts of a two-and-one-half-times increase in passenger miles in the next 20 years and a tripling of commercial transports in operation by the end of the century.

"Projected increases in population, commerce and tourism are expected to result in significant increases in long-distance transoceanic travel between various points in the developed and developing countries. To put it simply, it appears that if a greatly improved new fleet of transport aircraft can be developed in the next decade, a greatly enlarged traveling public will use it," the authors write.

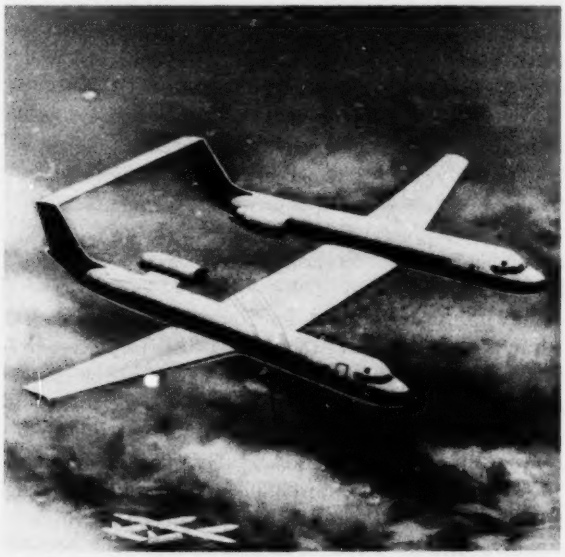
NASA and its industry and university partners are developing technology to make possible the predicted revolution in aeronautics. Dr. John Martin, NASA's former Associate Administrator for Aeronautics and Space Technology, reported to a Senate subcommittee that, "Today, the technology opportunities in aeronautics are probably greater than at any other time in our lifetime."

NASA, he said, is committed to a central role in the technology development required for superior U.S. civil and military aircraft because key elements of national and economic security are linked to preminence in aeronautics.

From new propulsion options and new structures and materials to computer-aided controls and displays, the technology is advancing rapidly. Even the study of aerodynamics, the granddaddy of all aeronautical disciplines, is promising bold new concepts for improved aircraft of the future.

A report commissioned by the Office of the White House Science Advisor identified three key national goals in aeronautics:

1. Subsonic Goal: To build trans-century renewal
2. Supersonic Goal: To attain long-distance efficiency
3. Transatmospheric Goal: To secure future options



Twin-fuselage transports like this artist's concept promise important aerodynamic and structural efficiencies over comparable single-fuselage aircraft.

The subsonic goal, in part, envisions technology for an entirely new generation of fuel-efficient, affordable U.S. aircraft operating in a modernized national airspace system. The supersonic goal, in part, develops pacing technologies for sustained supersonic cruise capability and enables linking the farthest reaches of the Pacific Rim in 4 to 5 hours. The transatmospheric goal pursues research to routinely cruise and maneuver into and out of Earth's atmosphere with takeoff and landing from conventional runways.

Technologies for the first two goals are outlined in the NASA "Impact" report. Technology realization will speed the nation into a new era in air transports.

The Subsonic Revolution

To passengers, the airliner of the next century could be very different in efficiency and performance, but look much the same as today's transport.

Ironically, the most obvious difference might be a return to propellers—improving the turboprop of the 1950's and 1960's to tap its great potential for fuel efficiency. Working with the propeller industry, NASA's Lewis Research Center, Cleveland, OH., has taken advantage of several technology advances in propeller blade structures and aerodynamics to dramatically reshape the propeller.

Mounted at the rear of the plane, the turboprop's huge, highly-swept blades might be in counter-rotating pairs on each side of the fuselage. Each propeller may have as many as eight or ten blades. This new system would carry people and cargo using 20 to 30 percent less fuel while matching the jet speed and cabin comfort of modern turbofan-powered aircraft.

Elements of NASA's advanced turboprop program include the "propfan test assessment" program to flight test a large-scale, single-rotation propeller in 1986. In one of several tests planned by NASA and industry in the next few years, a three-quarter scale, 9-foot diameter propeller will be put on an existing business jet to answer questions about structural integrity and noise levels.

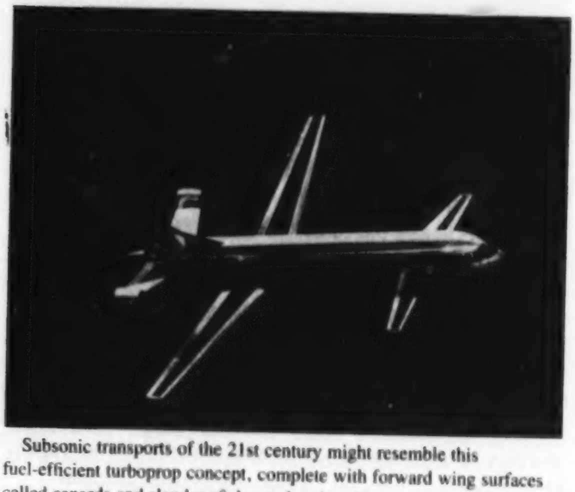
More subtle innovations will include new materials and new structural concepts, called composites, to make air transports of the 21st Century lighter and tougher. Thin filaments of graphite and epoxy could be wound in a continuous strand to form an airplane fuselage, much like rocket cases are manufactured. The layers could be part of a structural "sandwich" that would weigh 25 percent less than an aluminum-skinned and reinforced counterpart. Wing weight could be reduced even more through a combination of parallel advances.

The net payoff would be significant. A further contribution to fuel efficiency would be made, of course, and manufacturing costs would be reduced—parts count in an aircraft fuselage would be cut in half.

NASA hs invested about $160 million since initiating a cooperative program with industry in composite primary aircraft structures technology. Laboratory and flight tests have proven the toughness of large-scale advanced composite structures, successfully meeting damage tolerance and other criteria. A major program milestone was reached when five new transports were fitted with composite tail assemblies, marking the first use of composites for an essential transport structure. The aircraft are now in commercial service.

NASA ended the program a few months ago, having provided a data base which industry can now apply to new products. The agency will continue fundamental research into composite materials and structural concepts.

Passengers may look out their windows in the year 2005 and see long and slender wings, with aerodynamically-shaped cross sections for optional lift. The correct airfoil shape, combined with a perfectly smooth, wave-free skin, could result in "natural laminar air flow," where thin layers of air slide over the wing surface with a minimum of skin friction drag. The wings also might have nearly microscopic perforations or slots allowing air closest to the wing to be pumped from the surface—again to reduce drag, but this time, for active laminar air flow control.



Subsonic transports of the 21st century might resemble this fuel-efficient turboprop concept, complete with forward wing surfaces called canards and slender aft-located main wings.

The larger surface of the fuselage, where turbulent air flow is unavoidable, might have tiny grooves called "riblets" parallel to the direction of travel to reduce turbulent air drag. The grooves could be made of self-adhesive tape and applied directly to the aircraft surface. With the discovery of riblet-like scales on the skins of fast-swimming sharks, nature has confirmed the results of NASA research and wind tunnel tests.

Aerodynamic discoveries may be accelerated when a powerful, new supercomputer and simulation complex is fully operational at NASA's Ames Research Center, Mountain View, Calif. Soon to be the most advanced computational system in the world for aeronautical research and development, the Numerical Aerodynamic Simulation (NAS) Program will perform 1 billion computations per second by late 1987—more than three times faster than the previous generation of supercomputers. The computational fluid dynamics work, possible with NAS, will help researchers simulate conditions and flow phenomena difficult to measure physically, like the flows of air through the internal passages of turbine engines.

Passengers of the 21st Century might be surprised the first time they look into the cockpit to see computer terminals and television-like screens in place of the usual myriad of knobs, switches, indicators and electromechanical displays. Gone may be the traditional columns and wheels, replaced by less bulky side stick controllers. This "desk top" cockpit design would use the latest improvements in electronics to help the pilot and first officer become effective managers of increasingly complex aircraft flight systems.

The NASA study looked at combining these and other emerging technologies in a 200-passenger, 525 mph (Mach 0.78) airplane and concluded that the advantages are striking when compared with an advanced aluminum airplane with turbulent flow and turbofan engines. According to the report airplane weight would be reduced 30 percent and fuel efficiency would be more than doubled as a result of the combined technologies. At these values, the report goes on, "the airplane is more efficient than trains and buses in fuel consumption."

Radically new airplanes that would look and be very different promise even greater improvements if the aircraft industry, the public and financial institutions are willing to accept wide departures from conventional aircraft. Such a synergistic combination would result in maximum benefit of technologies expected by the end of the century.

A twin-fuselage airliner, for example, promises several advantages. Each of its two aircraft bodies (separated by a central wing section) could be the same size and construction as single-body transports made by the same company, allowing significant savings through a "family concept" of aircraft. Preliminary NASA studies show that a twin-body arrangement would be more aerodynamically efficient for the same payload and have much improved structural efficiency compared with an equivalent single-fuselage 400-passenger airplane.

The Supersonic Revolution

The revolution in technology improvements for subsonic air transports is well under way and will make the air transport of the 21st Century dramatically more economical—but that alone will not provide the spark to complete the revolution. When jet engine and swept-wing technologies combined in the jet era to entice people to fly more than ever before, it was the promise of shorter trip times that helped the revolution succeed. Flying faster, today, means flying beyond the speed of sound, beyond the capability of subsonic transports where special challenges remain.

NASA, which never totally stopped research and development of supersonic cruise technology, sees tremendous benefits in a renewed national commitment to SST.

"We should seriously consider a technology development program which would lead to an advanced SST early in the next century," advised Richard H. Petersen, Director, Langley Research Center, in a keynote address to a leading aerospace institute last year.

"Advanced technology, coupled with better understanding of the environmental issues and the changes which have occurred in the world travel market, has radically changed the prospects for an advanced supersonic transport," Petersen added.

Such a transport will eventually materialize, according to the Kayten, Driver and Maglieri report, as a result of the influence of the same technologies emerging for subsonic airplanes, the great strides made in military programs and the quarter century of focussed effort in supersonic cruise research that began with basic studies in the 1950's.

The new-generation supersonic transport can be economically attractive when compared with new-generation subsonic transports and with old generation supersonic transports, the report points out. Significant technological progress has taken place in the 20 years since the British-French Concorde and the ill-fated U.S. SST were designed. Further potential advances in aerodynamics, propulsion, and structural and systems weight, combined properly, suggest a vehicle with four times the fuel efficiency of Concorde.

This is possible, in part, because of the $1 billion invested by the United States in the national SST program between 1963 and 1971 when the program was cancelled. It is also possible because of a follow-on effort by NASA to solve the technological problems identified in the U.S. program (until funding was stopped for this, too, in 1981) and by the international experience gained after more than 80,000 hours of flight at twice the speed of sound (about 1,350 mph) in the Concorde.

A U.S. supersonic transport could be designed in the early 1990's with the range to fly directly across the Pacific Ocean at nearly three times the speed of sound, if the critical technologies are worked hard in the next few years. Trans-Atlantic flights could originate directly from the U.S. interior, initially flying subsonically.

At about 1,800 mph, a flight from Los Angeles to Toyko would take just over 3 hours in an advanced supersonic transport—compared with 10 hours subsonically. The ticket would cost the same or slightly more than for the equivalent subsonic flight, according to estimates by Kayten, Driver and Maglieri.

A supersonic transport inevitably costs more and has higher fuel consumption than an equivalent subsonic transport, but the key to keeping the fare down is offsetting these penalties by tremendous productivity. Because of its speed, a supersonic transport can generate many more passenger miles over its lifetime than a comparable-size subsonic transport.

A second generation SST could carry 250 passengers across the Pacific Ocean in little more than 3 hours.

The potential of developing technologies must first be realized to make sustained supersonic cruise at these speeds practical. An advanced SST has special technology needs in propulsion and heat-resistant materials. The achievement of supersonic laminar air flow control would further enhance the SST's performance by increasing aerodynamic efficiency.

Much effort was devoted by NASA in the 1970's to developing propulsion technologies for "variable cycle" engines, a promising concept for combining the supersonic cruise performance of a straight turbojet and the low-noise takeoff performance of today's subsonic turbofan. SST engine designers in the 1960's were forced to compromise performance, both at low speed and at supersonic cruise, to get a workable design, Petersen said in his address, but variable cycle engines can be matched to these demands with greatly reduced compromises and penalties.

Environmental concerns had a major role in the cancellation of the U.S. SST. The three prime concerns were airport-community noise, depletion of Earth's ozone layer in the upper atmosphere and sonic booms. In the 1970's, NASA gave each of these considerable attention and research. Technological advancements have done much to minimize jet noise, and the effect on upper atmospheric ozone was found to be insignificant. Sonic boom, however, continues to be a problem. Researchers are discovering how to reduce the intensity of sonic booms, but more work is needed before the next generation SST can fly supersonically over land.

"What can we now achieve with the technologies that we have developed in the last 20 years of hard work?" asked Petersen. "Recent preliminary design studies suggest an exciting two-engine, 250-passenger, advanced supersonic transport. It is an arrow (highly swept) wing configuration designed to cruise at Mach 2.7. It uses a superplastically formed and diffusion bonded titanium metal matrix structure and incorporates an advanced two-person cockpit, a sophisticated flight management system and fly-by-wire electronic control system.

"Clearly, there is no comparison between the potential performance of an advanced supersonic transport and the first generation SST's designed in the 1960's. We have roughly doubled both the payload and the range."

Beyond the year 2000, projected increases in population, commerce and tourism are expected to result in major increases in long-distance travel, particularly for Pacific crossings. A demand for 500 or more advanced SST's is conceivable.

Before all this happens, industry and government must be convinced to start investing in the plane's development, estimated to cost between $3 billion and $5 billion. An intensive, five-year, $500-million preliminary research program is what is needed now, according to Petersen.

In an article entitled "Future Developments Toward a Second-Generation SST," published in *World Aerospace Profile* in February 1986, Driver writes, "The advanced SST is inevitable. The technology is at hand and is bound to come by the early 1990's. The major remaining question is what country or countries will lead the supersonic revolution!"

President Awards Ames Chief 1986 National Medal of Science

Bernard M. Oliver, Chief of the Search for Extraterrestrial Intelligence (SETI) program at NASA's Ames Research Center, Mountain View, Calif., received the National Medal of Science from President Reagan.

Dr. Oliver's citation commends him "for translating the most profound discoveries of physics and communication science into the electrical, radio, and computer systems which have improved our culture and the lives of all Americans."

"It's in recognition of a lifetime of accomplishment in science," added Mary Gant of the White House Science Office.

Nineteen other scientists also received the award—the nation's highest scientific honor.

The National Medal of Science was established by Congress in 1959 to honor up to twenty Americans each year for achievements in science. According to the enacting legislation, the President awards the medal based on "the total impact of an individual's work on the present state of the physical, biological, mathematical, engineering, behavioral, or social sciences."

Oliver has contributed to many important fields since receiving his doctorate in electrical engineering at the California Institute of Technology in 1940.

While working for Bell Telephone Laboratories from 1940 to 1952, Oliver helped establish standards for television transmission, worked on automatic radar tracking, and advocated pulse-code modulation for the telephone system, a method of transmission that was later adopted by the telephone company.

Oliver joined Hewlett-Packard Company as director and later vice-president of research and development; he was named director of the corporation in 1973.

While at Hewlett-Packard, Oliver developed the first hand-held calculator with scientific functions, which appeared on store shelves in 1972 with a price tag of $395. His other innovations include the first programmable desk-top calculator with scientific functions.

After Oliver retired from Hewlett-Packard in 1983, NASA-Ames chose him to head its SETI program office. With antennas now used for radio astronomy and for Jet Propulsion Laboratory's Deep Space Network, the SETI program will scan the stars for radio signals that may be transmitted by intelligent extraterrestrial beings.

NASA and You

The Satellite Doctor

Henry Clay Hoffman believe that satellites can have as many lives as a cat. Like a family vet who nurses sick pets back to health, Hoffman rejuvenates NASA "birds" again and again and again.

Some say the slightly-built, dark-haired engineer thinks that dying satellites can be resurrected and that, like a witch doctor, he breathes life into ailing spacecraft with a special engineering mumbo-jumbo using arcane phrases like "poles and zeros, nulls and stability factors."

No matter how one looks at Hoffman, however, he is—by any measure—a unique individual whose name undoubtedly will go down in history as one of the greatest "fixers" of satellites the world has ever known.

Hoffman is Chief of the Guidance and Control Branch of the Space Technology Division at Goddard. He has been responsible for the technical development of spacecraft and launch vehicle stabilization, guidance and control subsystems since 1962. He also has developed a team of Goddard engineers who under his leadership, work as a team to keep spacecraft alive and well.

He has been instrumental in bringing back to life a number of satellites which without him, probably would have failed at a tremendous loss both in dollars and in science.

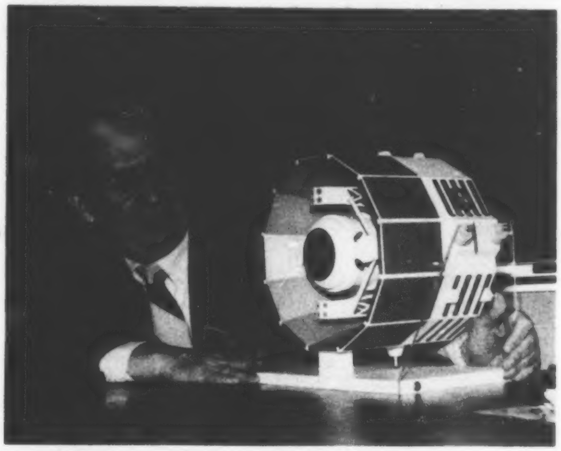
While he is widely respected for his technical expertise in designing and developing attitude control systems for a number of major NASA spacecraft, this enthusiastic engineer's recognition stretches far beyond the NASA arena. Over the last few years, he has gained an international reputation for his efforts of taking the "wobble" out of satellites that have lost their control systems hundreds and even thousands of miles above Earth.

On two occasions in 1980 and again in 1984, Hoffman played a major role in the re-stabilization of the Solar Maximum Mission (SMM) satellite, masterfully plucking it from doom with a touch of space magic that has brought him honors and fame the world over. Hoffman's leadership in developing the new control laws which stabilized Solar Max led directly to the historic first recovery and repair of a spacecraft in space.

When the stability of any NASA satellite is threatened, the first person to get a panic call for help is this Goddard engineer. Hoffman is always ready to jump in when his expertise is needed.

That was the case with the Tracking and Data Relay Satellite (TDRS) in 1983. It failed to reach geosynchronous orbit when its booster rocket failed shortly after deployment from the Space Shuttle. Hoffman made major contributions to a NASA-industry team that over a 59-day period, nursed the satellite more than 8,000 miles into its proper orbit using only six of the spacecrafts' thimble-sized thrusters. The achievement is considered one of the outstanding engineering feats in space history.

Hoffman thrives on problem solving. Perhaps this is why the recovery of the International Ultraviolet Explorer (IUE) is not only his most recent success story but also his project.



Henry Hoffman views a scale model of the IUE spacecraft.

Hoffman led a team of Goddard engineers who saved this 128 million dollar observatory after one of its three remaining gyros failed. Their highly unconventional and ingenious plan substituted the spacecraft's sunsensor for the missing gyro.

Observatory controllers placed the spacecraft in a yaw-spin configuration or "safe hold made" before feeding the plan to the IUE's onboard computers.

Hoffman currently is developing a standby plan to be implemented when another gyro fails.

Hoffman is the recipient of many awards including Goddard's 1985 Moe I. Shneebaum Memorial Award which is presented for outstanding accomplishments in the field of engineering. NASA awarded him with two Exceptional Service Medals, one in 1974 and the other in 1983. He won the NASA Exceptional Engineering Achievement Medal in 1984.

The National Society of Professional Engineers cited the TDRS rescue team, of which Hoffman was a key member, for one of the 10 most outstanding engineering achievements of 1983. Aviation Week and Space Technology cited his role as one of the top achievements of 1984.

In addition to the significant role that Hoffman has played in Goddard missions, he has applied his expertise to international and commercial programs such as Helios (German); Eole (French); INSAT (India); San Marco and LAGEOS II (Italian); Intasat (Spanish); the UK Series (British); Swedish sounding rockets; the Active Magnetospheric Tracer Explorers (AMPTE), and many of the Intelsat series of commercial communication satellites.

Much of his success is owed to the engineers with whom he works, according to Hoffman.

"I work with a top level team," he said. "We've been working together for a long time. Three of the people I work with now were already here when I came to Goddard in 1962."

When asked about retirement, Hoffman smiled and said: "I can stir a lot of pots and get my fingers into a lot of programs here at Goddard. I couldn't conceive of any other job in the world that would be as interesting or as challenging as the one I have here."

NASA Scientists Seek Cause Of East Coast Cyclones

Scientists from NASA's Goddard Space Flight Center, Greenbelt, Md., plus 25 other federal and private laboratories mounted the largest field experiment of its type, in an attempt to understand winter storms that annually wreak more than a billion dollars worth of havoc along the East Coast.

The experiment named GALE (Genesis of Atlantic Lows Experiment) funded and led by the National Science Foundation, was conducted over a 2-month period that ended March 15.

Scientists were concentrating their efforts on the coastal regions of North and South Carolina where winter storms, commonly known as cyclones, develop rapidly and move northward. The storms often have been hard to predict for many reasons including inadequate understanding of their processes and poor observation especially over the ocean.

According to Dr. Louis Uccellini, of the Severe Storms Branch, Laboratory for Atmospheres at Goddard, "The goal was to obtain observations of these storms and ultimately develop a numerical storm model for the region that will enable researchers to predict the birth of storms, their subsequent movement and their intensities."

The Severe Storms Branch, along with scientists from Goddard's Laboratory for Oceans, studied specific storm phenomena as part of a national team of research groups attempting to develop a total picture of cyclone behavior. The national team included some 200 scientists, engineers and technicians.

The NASA scientists studied two areas of storm behavior which traditionally have been simulated by numerical models rather than by eyewitness accounts or direct measurements.

Uccellini's group analyzed upper atmosphere conditions using temperature, moisture and wind sounding balloons launched every 3 hours from 40 sites administered by the National Oceanic and Atmospheric Administration (NOAA) throughout the Eastern third of the United States. The group also collected data from NASA's Nimbus 7 satellite, which carried an observing instrument called the Total Ozone Mapping System (TOMS). The TOMS provided a picture of the structure of the troposphere (ground level to 6 miles altitude) and the stratosphere (above 6 miles) as reflected by varying concentrations of ozone, one of the constituents of air.

Uccellini explained, "The data showed us how air masses were drawn into the troposphere from the stratosphere, possibly contributing to the development of cyclones. When the stratosphere descends in local spots the fast moving stratospheric air can rapidly tumble downward, setting up a circulation pattern that has great potential for developing a spin. But just how and when that happens is hard to predict and its interaction with lower tropospheric waves over the ocean is difficult to observe."

Scientists from the Laboratory for Oceans group, led by Dr. S. Harvey Melfi, associate chief for programs, studied how conditions at sea level influence storm development. The group flew five scheduled airplane flights to chart how moisture rises into the atmosphere from the ocean between storms.

"During the lulls between storms, very cold air from the arctic sweeps in behind the outgoing low-pressure zones off the Carolinas and comes into contact with the warm coastal water. At those times, a tremendous amount of heat and moisture is released into the lowest layer of the atmosphere, setting the stage for rapid development of another storm," Melfi stated. "We want to know how the moisture transfer takes place, and why some cyclones suddenly develop very quickly and begin dumping snow while others fizzle out," he concluded.

To study the moisture transfer into the atmosphere, flights were conducted over the ocean storm region in a four-engine Electra from NASA's Wallops Flight Facility on Virginia's Eastern Shore. On board was a combined laser/telescope called Lidar which detects salt spray and aerosols rising from the ocean into the air. As the laser is fired over the sea surface, the rising salt and dust particles are illuminated and can be observed by the telescope, providing measurements of the rising moisture and also its convection patterns.

Data on moisture in the atmosphere also was collected by NASA's high-altitude ER-2 aircraft carrying microwave radiometers able to detect water vapor and cloud liquid water content. The ER-2 airplane is managed by NASA's Ames Research Center, Mountain View, Calif.

NASA's Federal Engineer of the Year

James E. Kingsbury, Director, Space and Engineering, George C. Marshall Space Flight Center, Huntsville, Ala., was honored February 19 as NASA's Engineer of the Year during the National Society of Professional Engineers award banquet.

Mr. Kingsbury was a major influence in the successful development of the Saturn launch vehicles, and his extraordinary technical and managerial skills were invaluable during the design and development of the major Space Shuttle systems. He also directed the systems engineering task for the 1983 flight of Spacelab I, which resulted in major accomplishments in science and engineering.

Pictured from left to right are National Society of Professional Engineers President-elect Mr. Kuranz, Mr. Kingsbury, and NASA's Chief Engineer Dr. Silveira.

NASA Agrees To Canadian Space Station Hardware Proposal

NASA agreed to a proposal by the Ministry of State for Science and Technology of Canada to perform preliminary design of a Mobile Servicing Center during the remaining phase of the Space Station definition and preliminary design study (Phase B).

Canadian Prime Minister Brian Mulroney announced Canada's decision to proceed with Space Station participation March 18 during a visit to Washington, D.C. to meet with President Reagan.

The Mobile Servicing Center would be a multi-purpose structure equipped with manipulator arms that would be used to help assemble and maintain the Space Station, as well as help upkeep instruments and experiments mounted on the Station's framework.

The agreement between NASA Acting Administrator Dr. William Graham and Canadian Minister of State for Science and Technology Mr. Frank Oberle, marks an important milestone in the process of defining the function and content of hardware for the Space Station that could be provided by international partners.

The Mobile Servicing Center would consist of a base structure with accommodations for payloads, orbital replacement units, utilities and thermal control. Included with this structure would be the Space Station Remote Manipulator System, end-effectors and servicing tools, and special-purpose dextrous manipulators. As an adjunct to the design of a Mobile Servicing Center, Canada also will perform preliminary design on a fixed servicing site which could be used for working on attached payloads and for storing the spare parts carried on the Mobile Servicing Center.

NASA is conducting preliminary design of hardware for servicing sites on the Space Station. NASA also is conducting preliminary design of a flight telerobotic system which employs a dextrous robotic device for working on spacecraft brought to the Station, or for in-situ servicing, repair and refurbishment of remote spacecraft when used as the "smart front-end" of an Orbital Maneuvering System.

This agreement covers design work during the remainder of the Phase B period, which extends through January 1987. A formal decision by Canada to proceed with the development, operation and utilization of the Space Station will be subject to successful completion of Phase B activities, to the satisfactory negotiation of an arrangement for cooperation, and to the availability of funds.

NASA expects to complete the definition portion of the Phase B effort in the next few weeks. This will lead to the selection of a baseline configuration for the permanently manned Space Station, which will guide preliminary design activities for the remainder of the Phase B program. Space Station development is scheduled to begin in mid-1987 and lead to an initial orbiting capability by 1994.

NASA Schedules Five Expendable Launches For 1986

Five satellites will be placed in Earth orbit by NASA in 1986 using Delta and Atlas Centaur rockets. The launches include two Geosynchronous Operational Environmental Satellites (GOES), two Fleet Satellite Communication (FLTSATCOM) satellites and one Department of Defense mission.

The GOES satellites for the National Oceanic and Atmospheric Administration (NOAA) are an improved version of geostationary meteorological spacecraft providing day and night pictures as well as vertical temperature and moisture data in the atmosphere for use in weather forecasting. They also will collect and relay data from remote automated facilities including ocean buoys, rain gauges, river and tide gauges and automated weather-observing facilities. In addition, the satellites detect solar activity that impacts radio transmissions among other environmental effects.

The FLTSATCOM satellites are a second generation series of geostationary communications spacecraft to be shared by the Navy, Air Force and other entities within the Department of Defense, including the Strategic Air Command and the Presidential Command Network. They provide secure communications between land-based facilities and ships, submarines and aircraft. The Navy is the lead agency for the FLTSATCOM series.

Delta 180 will launch a mission for the Department of Defense which will support the research and development effort for the Strategic Defense Initiative.

Delta rockets are launched under the management of a joint NASA/McDonnell Douglas Astronautics launch team. Atlas Centaurs (AC) are managed by a joint NASA/General Dynamics Convair launch team.

Schedule Of Expendable Launches From Cape Canaveral

May 1	Delta 178	Complex 17	Pad A	GOES-G
May 22	AC-66	Complex 36	Pad B	FLTSATCOM-F
Aug. 14	Delta 180	Complex 17	Pad B	DOD
Oct. 9	Delta 179	Complex 17	Pad A	GOES-H
Nov. 6	AC-67	Complex 36	Pad B	FLTSATCOM-G

Heard From Around The World

Britain—The HOTOL spaceplane concept being developed by British Aerospace Space and Communications Division received funding of 3 million dollars from the UK Department of Trade and Industry, which will be matched dollar for dollar by British Aerospace themselves and by Rolls-Royce, whose Derby subsidiary is working on proof-of-concept studies on HOTOL's revolutionary air-breathing rocket engine.

HOTOL is competing with France's Hermes mini-Shuttle project to become Europe's next-generation satellite-launching vehicle.

Due to pressure of work at British Aerospace's Stevenage facility, the HOTOL program is to be centered on the company's Military Aircraft Division at Warton, near Preston in Lancashire.

NASA Scientist Awarded International Astronomy Medal

Dr. Albert Boggess, Space Telescope project scientist for operations at NASA's Goddard Space Flight Center, Greenbelt, Md., was named the co-recipient of the Herschel Medal, awarded by the Council of the Royal Astronomical Society of the United Kingdom.

Boggess was cited for his contribution to the success of the International Ultraviolet Explorer (IUE) satellite. He served as IUE project scientist from the development phase, through the first several years of operation, including the January 1978 launch of the spacecraft.

Professor R. Wilson, University of London, was the co-awardee of the Herschel Medal, which is awarded once every 3 years for exceptional contributions to observational astronomy.

The IUE is continuing a 10-month program to study Comet Halley's evolution as it approaches and then recedes from the sun. The research centers on the comet's physical and chemical properties.

The satellite maintains a quasi-geosynchronous orbit over the Atlantic Ocean, which allows it to be in contact with ground observation sites at Goddard and Villafranca, Spain, an observing site near Madrid.

The IUE is a joint project of NASA, the European Space Agency and Britain's Science Research Council.

NASA To Participate In High Energy Solar Physics Program

NASA released an announcement of opportunity for U.S. scientists to participate in the High Energy Solar Physics program (HESP), sponsored by the Institute of Space and Astronautical Science (ISAS) of Japan. The HESP mission is planned for launch into low-Earth orbit in the early 1990s.

The goal of the HESP mission is to advance the understanding of high energy phenomena on the sun through X-ray and gamma ray observations taken by a carefully coördinated set of instruments carried on a spacecraft intended to be built and launched by ISAS. HESP will continue the systematic study of high energy solar processes started by the NASA Solar Maximum Mission and the ISAS Hinotori mission, both orbited in the early 1980s during the last epoch of maximum solar activity.

ISAS invited U.S. scientists' participation through NASA, under terms of the U.S.-Japan agreement on cooperation in research and development. This particular announcement of opportunity limits participation, both principal investigators and co-investigators, to scientists from U.S. institutions.

The solicitation by NASA for participation in the HESP mission was for a single scientific investigation from a small team of U.S. scientists who will analyze data derived from the HESP payload for the study and understanding of both energetic and quiet solar phenomena. The successful U.S. investigation team will be expected to help design and construct a soft X-ray telescope for the HESP payload, in conjunction with Japanese HESP scientists.

While ISAS anticipates final approval and funding for the HESP mission, such approval is not final as of the date of the announcement of opportunity. In the event HESP is not formally approved, no obligation is placed on the U.S. government to carry any selected investigation through to completion. Confirmation of any selections made for final development for flight will be contingent on conclusion of an agreement between NASA and ISAS, which will be negotiated during the coming year.

Contractor News

NASA selected **Boeing Aerospace Co.,** Seattle, for negotiations leading to the award of a contract to provide Shuttle upper stages to place two Tracking and Data Relay Satellites—TDRS-E and TDRS-F—into geosynchronous Earth orbits.

In addition to providing Shuttle upper stage hardware, the contractor will provide engineering, support and integration of the upper stages with the satellites, and support to the cargo (the combined upper stage and satellite) integration with the Space Transportation System. The contractor also will be responsible for postflight evaluation reports.

The contract runs from March 1986 through April 1990 with a proposed price of approximately $93 million. It is anticipated the agreement will be a fixed-price-incentive contract with incentives on cost, schedule and performance. The contract will contain options for storage of the upper stages.

NASA's Goddard Space Flight Center, Greenbelt, Md., selected **Science Applications Research,** Lanham, Md., to negotiate a cost-plus-award fee contract for operations and analysis support for the National Space Science Data Center at Goddard.

The contract, will consist of a 3-year basic period of performance and a 2-year unpriced option. Additionally, a separate firm-fixed-price phase-in contract of 2 months duration will be negotiated.

The total proposed estimated cost and fees for the basic 3-year period is $10,577,000. The procurement is a consolidation of work currently performed under several contracts.

Langley Research Center Director Richard H. Peterson presents Chris Gross with a Certificate of Recognition and a monetary award for his invention of an Electronically Scanned Pressure (ESP) Sensor which replaced the mechanically scanned pressure sensor. This invention resulted in better data quality and significant cost reduction in wind tunnel pressure measurements. Since 1980 Gross has worked at Pressure Systems, Inc., a company formed and licensed by NASA to manufacture and market the system. To date Pressure Systems has sold more than 50,000 channels of ESP sensors to the major laboratories and companies of the free world.

Did You Know?

The United States Space Foundation outlined to NASA officials plans to provide a central national focal point for a variety of individual fund raising activities related to construction of a replacement orbiter for the Challenger.

The foundation is a private, non-profit, educational organization established to stimulate international dialogue on the beneficial uses of space and to integrate space education materials into the curriculum of schools at all levels.

Pursuant to its plan, the foundation has established the Challenger 7 Fund which already has received significant dollar contributions and has marshalled the support of a number of individuals and organizations. The foundation ultimately plans to donate the contributions to NASA for its use in financing a replacement orbiter should the U.S. Congress authorize a replacement.

A tenth anniversary Viking Project reunion will be held at the NASA Langley Research Center, Hampton, Va., on Saturday, July 19, 1986. For further information or reservations contact:

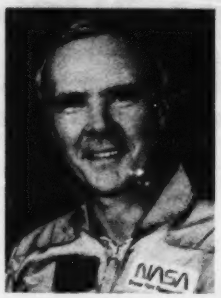
Jesse Timmons
Mail Stop 433
NASA Langley Research Center
Hampton, VA 23665
(804) 865-4621

NASA's International Ultraviolet Explorer (IUE) orbiting telescope conducted complementary observations of Comet Halley during the recent encounters of the comet by Soviet, European, and Japanese spacecraft.

The IUE telescope, which was launched in January 1978, devoted more than 250 hours of its operation to watching Comet Halley—more hours than the telescope devoted to any of its previous targets in one year.

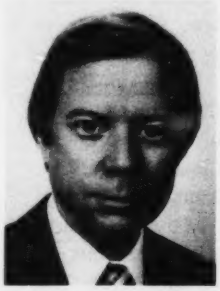
Jack N. Nielsen, Ph.D., Chief Scientist at NASA's Ames Research Center, Mountain View, Calif., was elected to membership as one of 73 new members named by the National Academy of Engineering for 1986. He will receive his award at Academy ceremonies in October, in Washington, D.C.

Election to the Academy is considered by most engineers to be the highest professional distinction that can be conferred on an engineer. Election to membership is designed to honor individuals who have made "important contributions to engineering literature of engineering, or those who have demonstrated "unusual accomplishments in new and developing fields of technology."



Thomas C. McMurtry was appointed Chief of the NASA Ames-Dryden Flight Research Facility's Research Aircraft Operations Division.

The Research Aircraft Operations Division is responsible for operating and maintaining all aircraft assigned to the Ames-Dryden Facility. This includes research aircraft such as the X-29, the Advanced Fighter Technology Integration/F-111, an F-15 used for advanced propulsion research, and an F-14 and JetStar aircraft used for laminar flow programs, as well as F-104s and F-18s used for chase and proficiency flying.



Dr. Raymond S. Colladay, the Associate Administrator for Aeronautics and Space Technology (OAST), recently completed Harvard University's Advanced Management Program (AMP), a residential program providing a general management point of view by broadening outlooks, refining skills and knowledge, and strengthening competence in long-range policy making. Harvard's Advanced Management Program afforded Dr. Colladay the opportunity to increase his knowledge of management concepts and practices, to learn from the experiences of other high-level managers and to broaden his perspective on the interrelationships between government and private industry in research and technology efforts.

Carolyn E. Floyd, a Technical Information Specialist at the Langley Research Center, participated in the Middle Management Program for Women at Simmons College.

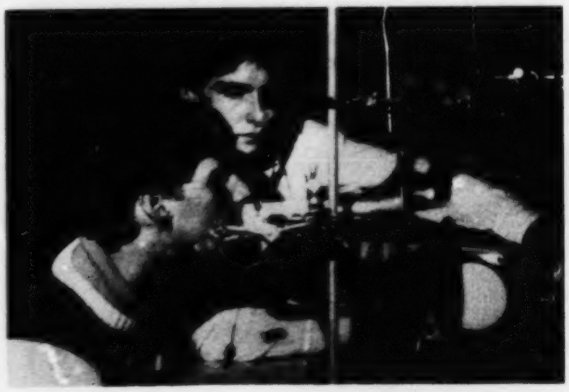
The program is a 10-week executive development program designed to assist employees in industry, government agencies, and the non-profit sector to prepare qualified women for positions in middle management.

Participating in the Simmons College, Middle Management Program has enhanced Ms. Floyd's capabilities in decision making, planning, budgeting, leadership, communication and supervisory skills.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans — and at a tiny percentage of the tax dollar. Here is an example:

Lung Diagnosis



Disabling lung illnesses may develop from exposure to adverse occupational or environmental conditions, innate defects in the anatomy or function of the lungs, allergic responses, asthma, prolonged cigarette smoking and other conditions. Early detection, accurate diagnosis and immediate initiation of therapy improve the chances for successful treatment to forestall later stages of pulmonary illnesses. There is evident need for new, more sensitive, and more specific methods of insuring early detection of pulmonary abnormalities.

NASA research in aeroacoustics, the study of aircraft sound production toward reducing noise and vibration, has provided a theoretical basis for a mathematical-physical model of the production of human respiratory sounds, specifically "breath sounds." In theory, a particular polmonary illness causes characteristic anatomic changes or changes in the reactivity of the bronchi, and therefore of airflow through different regions of the lung. Since early changes in respiratory response to a variety of stimuli are indicators of later disease, it is imperative to develop highly sensitive methods of detecting and following the time course of such early changes.

A theory of breath sound generation based on the interactions of vortices in the pulmonary airways has been developed and validated through extensive test data acquired by Langley Research Center, Hampton, Va./Medical College of Virginia (Richmond) researchers. The intent of the project is to develop a technique of sufficient sensitivity to break down human respiratory sounds (as these sounds are changed by dysfunction) into their spectral frequency and amplitude components. In human testing (upper right), changes in breath sounds in the pulmonary airways are recorded and analyzed by a number of complex instruments normally associated with aeroacoustic research.

The research team includes Langley aeroacoustics experts Dr. Jay C. Hardin and Dr. John M. Seiner; Dr. John L. Patterson, Jr., principal investigator, Joseph E. Levasseur, together with medical and pre-medical students and collaborating faculty of the Medical College of Virginia. The NASA-sponsored Research Triangle Institute Applications Team, Research Triangle Park, North Carolina. Bruel and Kjaer Instruments, Inc., Marlboro, Massachusetts, is supporting the project with engineering consultation and equipment. Interested in the system's commercial potential, Bruel and Kjaer predicts a market for a diagnostic and monitoring device in industrial employee check-up centers, as well as in the offices of specialists in respiratory disease, in clinics and in hospitals.

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* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

*U.S. GOVERNMENT PRINTING OFFICE: 1986- 491-575:20008

17/5

NASA Activities

National
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Space
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May 1986
Vol. 17, No. 5

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"It is going to take a lot of hard work, but I am confident that we will get going again. We have the dedicated professionals who I know will do the job right, and I am very proud to be here to help."—NASA Administrator Dr. James C. Fletcher.

NAS 1.46:

About the Cover

As President Ronald Reagan looks on, Vice President George Bush swears in Dr. James C. Fletcher on May 12, 1986 to become NASA's 7th Administrator. His wife Fay holds the bible as her husband takes the oath.

Dr. Fletcher is the first man to head the nation's civilian space agency on two separate occasions. He was the 4th NASA Administrator from April 1971 to May 1977.

Contents

NASA Honors 1985 Inventor Of the Year 3
Commercial Development Center Candidates Named 3
Space Agriculture Researched.......... 4
NASA Chief Scientist Elected to NAS 5
Scientists To Study Thunderstorms.......... 5
Director Named For NSTL Center 6
New Communications Network To Connect NASA Locations 7
NASA Scientist Wins Career Achievement Award 8
Mars Observer Investigations Selected 8
Good Sleep Strategy May Reduce Pilot Fatigue.......... 10
From The Congressional Record.......... 12
Disease Mapping In Africa 13
Contractor News 13
Did You Know?.......... 14
Another Dividend From Air And Space 16

NASA Activities is published monthly by the National Aeronautics and Space Administration for the information of the agency's employees. Contributions and recommendations are solicited from Headquarters and field centers, and should be addressed to Editor, NASA Activities, News and Information Branch, Code LFD-2, Washington, D.C. 20546. Material submitted for publication cannot be returned.

Distributed free of charge only to current agency employees. Available by subscription from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Check or money order should be made payable to Superintendent of Documents, GPO. Subscription rates are $23.00/year, domestic; $28.75/year, foreign.

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NASA Honors 1985 Inventor Of The Year

George L. von Pragenau of the Systems Dynamics Laboratory at the Marshall Space Flight Center, Huntsville, Ala., was selected as the 1985 NASA Inventor of the Year.

Von Pragenau's selection was based on his invention of a damping seal for turbo machinery. The seal is "an extraordinary technical advancement in promoting high speed rotor stabilization," said Center Director Dr. William R. Lucas in nominating von Pragenau. "It provides unexpected stability and damping to the rotor and it easily replaces existing labyrinth and other seals of turbomachinery without changing their fluid leakage characteristics."

The damping seal reduces turbomachinery whirl — a whipping or lateral vibration motion of a rotor which usually appears at some speed or power level and prevents further increases. This type of vibration is very destructive because the rotor is whirling at a speed different from its rotational speed.

Von Pragenau's invention is now being incorporated into pumps of the Space Shuttle main engine to enable them to run at increased speed and power levels.

In the past, the NASA Inventor of the Year also has been NASA's Nominee for the National Inventor of the Year Award presented by the Intellectual Property Owners, Inc. This year, for the first time, one inventor was selected as the NASA Inventor of the Year and two co-inventors were selected as NASA's nominees for the National Inventor of the Year Award.

George L. von Pragenau, left, is pictured with NASA's General Counsel John E. O'Brien.

The change was made because NASA opted to give separate detailed consideration to the criteria detail for each award. The NASA award emphasizes technical merit of an invention; whereas, the national award emphasizes commercial sales and availability, as well as technical merit. An invention could meet the criteria of both awards, but the inventions considered this year did not.

The NASA nominees for the National Inventor of the Year Award were Anne K. St. Clair and Terry L. St. Clair of the Langley Research Center. They were recognized for their invention of high temperature laminates and the process for preparing them.

This is the second straight year a Marshall employee has been named NASA Inventor of the Year.

Commercial Development Center Candidates Named

NASA announced the 25 teams which submitted proposals to its second solicitation to establish Centers for the Commercial Development of Space.

The objective of these centers is to stimulate high technology research in the microgravity environment of space. This research eventually will lead to the development of new products which either have commercial potential or contribute to possible commercial ventures.

The research areas proposed include semiconductor crystal growth, remote sensing, communication technology, biotechnology and space services.

NASA's Office of Commercial Programs, Washington, D.C., received proposals from industry/university consortiums in response to a program solicitation.

Proposals were received from the following lead institutions:

Florida Institute of Technology
Research & Engineering
Melbourne, Fla.

Clarkson University
Potsdam, N.Y.

Southwest Biotechnology Center
Albuquerque, N.M.

University of Massachusetts
Polymer Research Institute
Amherst, Mass.

University of Wisconsin
Madison, Wis.

Stanford University
Stanford, Calif.

Worcester Polytechnic Institute
Center for Fire Safety Studies
Worcester, Mass.

Midwest Research Institute
Kansas City, Mo.

Texas A&M University
College Station, Texas

Aeroconsortium
Wrightwood, Calif.

Tulane University
New Orleans, La.

University of New Mexico
Center of High Technology Materials
Albuquerque, N.M.

Weber State College
Center for Aerospace Technology
Ogden, Utah

Georgia Institute of Technology
Atlanta, Ga.

University of Houston
Houston, Texas

Southeastern Massachusetts University
North Dartmouth, Mass.

Ohio State University
Columbus, Ohio

Case Western Reserve University
Cleveland, Ohio

University of New Mexico
Technology Application Center
Albuquerque, N.M.

Southeast Florida Educational Consortium
Miami, Fla.

Woods Hole Oceanographic Institution
Woods Hole, Mass.

Massachusetts Institute of Technology
Cambridge, Mass.

Southwest Research Institute
San Antonio, Texas

Center for Innovative Technology
Herndon, Va.

Clemson University
Clemson, S.C.

The proposals currently are being reviewed by a panel of technical, managerial and financial experts. The review is expected to take 45-60 days.

Space Agriculture Researched

In an effort to prepare for long duration manned missions, NASA has launched a research program to grow food in outer space.

At present, all NASA manned missions have been short enough to allow adequate amounts of air, water and food to be taken aboard the spacecraft. However, as missions become longer, it will be necessary to regenerate the air, water and food supply within the spacecraft.

NASA's Kennedy Space Center, Fla., has provided a research grant to Tuskegee University, Tuskegee, Ala., to select several sweet potato varieties that look promising for space cultivation. The first year's research grant will total approximately $200,000 with 2 option years to be determined as the research continues.

Tuskegee's Carver Research Foundation will conduct the project and also will research nutrient delivery and hydroponic systems best suited to the development of the root crop.

The sweet potato will be used in NASA's Controlled Ecological Life Support Systems (CELSS) program, which is searching for methods to supply a continuous food source and to regenerate waste during long space flights or for proposed lunar colonies.

Dr. William Knott, manager of KSC's Life Science Support Facility, who also is the technical monitor for the project, says if the sweet potato can deliver enough energy conversion efficiency and productivity, it will be incorporated in a nearly full-scale "breadboard" of a working CELSS which NASA is developing.

The research will focus on three systems: plant growth, food processing and waste management. The program will begin with plant growth in a large sealed chamber to determine its growth potential in a nutrient system. Further research would involve propagation of the plant, refining the nutrient system and learning how to optimize its growth.

The plants will be studied in a sealed 24-by-12-foot growth chamber for periods of time with controlled light, food, water and temperature. In the chamber environment, plants will be fed by recycling the atmosphere and the water that passes through the nutrient system.

The chamber, which once was used to test the Mercury spacecraft for flight, may produce enough food for two to three people. Presently, enough food can be grown continuously to meet about half the needs of a single person. Leftovers from the recycling process would be treated in a waste management system that would convert the waste products into a nutrient source for the plants.

Knott said that harvesting the highest yields possible using a minimum of space and water to deliver nutrients to the plants is a major challenge of the project. "We will take the edible seeds and fruit out the chamber for processing and storage. The leaves, stems, and parts of the plant normally not consumed also need to be converted into a food material," he said.

Calling the CELSS program "a beyond the year 2000 endeavor," Knott said some of the concepts of the program could be tested on the Space Station "just to see if they work." The Space Station will be built in low-Earth orbit, making it easy to replenish the astronauts food supply rather than add a growth chamber's demands for power and weight to the station's own requirements. However, he continued, "resupply on a long duration space flight, a lunar base or a Mars mission is far less practical, making the 'space farm' appear much more attractive."

The sweet potato was selected primarily for its nutritional value. It is also a versatile plant that can be roasted, fried, souffled, and mixed into breads, cakes, or pies. Other plants previously chosen for the CELSS breadboard project include sugar beets, lettuce, snap bean, wheat, soy beans and white potatoes.

Dr. Margaret Tolbert is director of the Carver Research Foundation, Tuskegee University, and Dr. Walter A. Hill, an associate professor in the School of Agriculture, is principal investigator for the project.

NASA Chief Scientist Elected Member Of U.S. National Academy Of Sciences

Dr. Frank B. McDonald, NASA Chief Scientist, was elected to membership of the U.S. National Academy of Sciences. Election to membership in the Academy is considered to be one of the highest honors that can be accorded an American scientist or engineer. The election was held on April 29, 1986, during the business session of the 123rd annual meeting of the Academy at which 59 new members were selected in recognition of their distinguished and continuing achievements in original research.

Prior to becoming NASA Chief Scientist in September 1982, Dr. McDonald was a member of the scientific staff of the Goddard Space Flight Center, Greenbelt, Md. where he began his NASA career in 1959 as head of the Energetic Particles Branch. In his years at Goddard, he was project scientist on nine NASA satellite programs and the principal investigator for many space experiments. In 1970 he became Chief of the Laboratory for High Energy Astrophysics. In 1982 he was detailed to the White House Office of Science and Technology Policy as a sensor policy analyst.

Concurrent with his NASA career, Frank McDonald has been Adjunct Professor of Physics at the University of Maryland, College Park. Prior to joining NASA, he was an assistant professor of physics at the University of Iowa, Iowa City. McDonald received his bachelor's degree from Duke University in 1948, and his master's (1951) and doctorate (1955) degrees from the University of Minnesota.

McDonald is a member of numerous professional and honorary societies including Phi Beta Kappa, Sigma Xi, the American Geophysical Union, the American Physical Society, and the American Astronomical Society.

In addition to his election to the National Academy of Sciences, he has received two awards for Exceptional Scientific Achievement; the Presidential Rank of Meritorious Executive; the NASA Outstanding Leadership Medal and the Lindsay Award.

The National Academy of Sciences is a private organization of scientists and engineers dedicated to the furtherance of science and its use for the general welfare. The Academy was established in 1863 by a Congressional Act of Incorporation, signed by Abraham Lincoln, that calls upon the Academy to act as an official advisor to the federal government, upon request, in any manner of science or technology. This provision accounts for the close ties that have always existed between the Academy and the government, although the Academy is not a government agency. The new members elected in April bring the total to 1,477 members.

Scientists To Study Thunderstorms In Cooperative Effort

Atmospheric scientists from the Marshall Space Flight Center in Huntsville, Ala., the University of Chicago and the Federal Aviation Administration are coming together this spring in the Tennessee Valley to conduct an experiment to understand how thunderstorms begin and end.

The experiment, called the Cooperative Huntsville Meteorological Experiment (COHMEX), will attempt to determine how to predict cloud formation and rainfall, examine sudden downbursts that cause jetliners to crash, and determine if those downbursts can be detected in time to warn pilots and boaters.

COHMEX is the combination of three independent atmospheric projects — the Satellite Precipitation and Cloud Experiment (SPACE), the Microburst and Severe Thunderstorms (MIST) experiment, and the FAA-Lincoln Laboratory Operational Weather Studies (FLOWS).

Marshall is in charge of the Satellite Precipitation and Cloud Experiment and will help coordinate all three. The cooperative experiment began in March and will continue through August, with the most intense operations scheduled from June 2 through July 21.

The goal of the SPACE experiment is designed to better understand processes of the atmosphere that lead to precipitating clouds and storm electrification lightning, and through that understanding develop sensors that are capable of producing meaningful measurements.

The Microburst and Severe Thunderstorm experiment, sponsored by the National Science Foundation, seeks to understand the structure of microbursts — sudden, sharp flows of air that drop without warning from a decaying thunderstorm and dissipate in minutes. It is estimated microbursts have been responsible for 25 air crashes and 500 deaths in the last decade. Until microbursts were identified in 1975, they were often mistaken for tornadoes and other phenomena.

The FAA-Lincoln Operational Weather Studies (FLOWS) investigators will attempt to establish more clearly what the clues are that can be used in predicting microbursts, while supporting the SPACE and FLOWS.

COHMEX is "rather unusual in that you are bringing together three agencies in a cooperative environment," said SPACE coordinator James Arnold of Marshall. "It ranges from space sensor development to scientific understanding to operational readiness, and calls upon every technique from rain gauges and balloons to doppler radar and satellites."

Although the goals of the three experiments in COHMEX are largely independent, they all have common needs. Most demanding is the collection of weather information on a microscopic scale compared to the less-detailed maps most people see on television. Each experiment will have access to measurements taken by the other two, which may help investigators understand forces shaping the phenomena under study.

To accomplish this, the atmospheric conditions around Huntsville and the Tennessee Valley will be scrutinized by five doppler radars to measure wind speed and direction, plus standard weather radar; high-altitude survey planes to fly over, around and through storms; networks of automated stations on the ground to report conditions every minute and aloft on balloons released as often as every 90 minutes; weather satellites to take global and regional measurements; and dozens of computers from small personal computers to large super-computers to gather data, make it accessible and reduce it to an understandable form.

Huntsville was selected for the cooperative experiment because of the facilities available, the plans Marshall had for SPACE, and the weather in the area — severe tornadoes in early spring and violent microbursts that occur in May, June and July. Other advantages include the lack of heavy aircraft traffic in the area that would restrict research aircraft operations, and the rolling farmland that reduces the clutter seen by radar.

Marshall will serve as the common operations center and will be assisted by Army meteorologists at the Redstone Arsenal. "Key players in the experiment will be the Man-Computer Interactive Data Acquisition System McIDAS and an Interactive Computer Radar Display," said Arnold. "McIDAS will be providing displays of weather data and forecasts, while the Interactive Computer Radar Display will provide a specialized view from the Nashville, Tenn., airport weather radar, which has a new image processor."

By November, an operations summary and data inventory will be available to guide investigators in picking what part of COHMEX they wish to study. Then the hard work begins with the science teams analyzing their finds and turning them into hard results, according to Arnold.

Director Named For NSTL Center

The Institute for Technology Development named Dr. Carl Schueler director of its Space Remote Sensing Center at NASA's National Space Technology Laboratories, Miss.

The center was established by a competitive grant award from NASA in December 1985 as a division of ITD, a private, non-profit, Jackson-based corporation. One of ITD's goals is to promote and develop technology to benefit the nation. SRSC is actively pursuing this corporate goal through the development of commercial applications of remote sensing technology.

SRSC plans to create partnerships between industry, academia, NASA and other government agencies to reduce the technical, financial and institutional risks to developing new remote sensing products and services.

NASA has been the leader in space remote sensing research and has the charter to broadly promote the beneficial use of remote sensing data as is expressed in the 1984 Land Remote Sensing Commercialization Act.

Schueler noted that one of the center's first efforts will be to assess other capabilities at NSTL and elsewhere in the government and how SRSC can help those agencies become part of the important U.S. venture to put remote sensing applications technology into the private sector.

Schueler stressed the center is a non-profit business which needs to invest in research and development projects with the expectation of obtaining a return on that investment to support further endeavors. He stated, "We are investing both corporate and government dollars with the goal of building self-sustaining applications in remote sensing. This means we have no choice but to invest in research and development which promises to lead to commercially profitable ventures."

Schueler comes to the center from the Hughes Aircraft Co. in Santa Barbara, Calif., where he served as manager of the Advanced Applications Department in the Space Sensors Laboratory. He is joined by Dr. George May, from the U.S. Department of Agriculture in Sacramento, Calif., who will serve as the center's program manager.

"It is going to take a coordinated effort by a strong team of people with complementary experience, knowledge and talent to make the center a success," Schueler said.

The center will ultimately be housed in the Mississippi Technology Transfer Center scheduled for completion in mid-1987.

New Communications Network To Connect NASA Locations

A new, common-user NASA communications network that will interconnect NASA Headquarters, Washington, D.C., seven centers and various operating locations has become operational.

The Marshall Space Flight Center in Huntsville, Ala., is responsible for the management, operation and maintenance of the network for NASA.

Called the Program Support Communication Network, the new integrated digital network combines into one system all of the agency's program support communications services.

The network provides Federal Telephone System long distance telephone service among NASA facilities, packet and circuit switched data communications, facsimile, electronic mail, and voice teleconferencing. Video teleconferencing is a planned addition during 1987. It also provides a new computer network service to provide high volume data transfer among large Class VI computers at Office of Aeronautics and Space Technology centers. The network uses a computer-controlled switching unit that combines the service elements into a network and removes the need for multiple transmission circuits.

NASA is the first government agency to integrate all voice, data, message and video services into a single, fully digital network.

Once fully completed, the network will interconnect 16 locations and will handle agency-wide communications traffic employing satellite and terrestrial, high-speed digital circuits.

Among the benefits the network will provide NASA are improved quality and variety of communications services, rapid response to new or changed user services, advanced information exchange capabilities to reduce or avoid other direct NASA costs and data on service use for future planning and maintenance of the network configuration.

Six NASA locations are presently interconnected by the network. They include NASA Headquarters, Marshall, Goddard Space Flight Center, Johnson Space Center, Kennedy Space Center, and the Dryden Flight Research Facility.

Nine more locations will be added to the network by the end of July. They include the Ames Research Center, the Langley Research Center, the Jet Propulsion Laboratory, Marshall's Slidell Computer Complex and Michoud Assembly Facility, the Wallops Flight Facility, the National Space Technology Laboratories, and the NASA facilities at White Sands and Vandenberg Air Force Base.

The final location, Lewis Research Center, will be brought on line later in the year.

Implementation of the network began during 1985. The project involved designing the network, installing and testing equipment at each center, coordination of transmission services and earth station installation.

A portion of the communications services, including facsimile equipment and voice teleconferencing equipment to be provided as part of the network, were installed by the end of 1985.

Satellite transmission was operational at Marshall, Johnson Space Center and the Dryden Flight Research Facility by the middle of March.

Boeing Computer Support Services, Inc., designed the network and is the network management contractor. Boeing is supported in this effort by over 70 subcontractors and suppliers.

NASA Scientist Wins Career Achievement Award

NASA selected Dr. Alan Rembaum, Jet Propulsion Laboratory (JPL) Pasadena, Calif., to receive a career award of $10,000 for "exceptional scientific and technical contributions."

Dr. Rembaum, who retired in 1985, was cited for the origination of important new classes of polymers and significant advancements in polymer chemistry.

The award was presented on Friday April 4 by Dr. Lew Allen, Director, Jet Propulsion Laboratory. Rembaum was recommended by the NASA Inventions and Contributions Board and approved by then Acting Administrator Dr. William R. Graham.

During a 24-year career at JPL, Rembaum was the inventor or co-inventor of 52 patented contributions, twice the number of any other JPL employee. He is the author or co-author of some 200 scientific papers published in professional journals.

JPL Director Dr. Lew Allen is pictured with Dr. Alan Rembaum (seated), family members, and JPL management.

Rembaum was responsible for repeated advances in the field of polymer chemistry with applications to problems in biology and molecules of the same substances. The NASA scientist developed polymeric microspheres which could be coupled with suitable antibodies in the treatment of cancer. His JPL team also developed the first all solid state polymeric electrolyte storage battery, now used in heart pace-makers throughout the world.

Rembaum investigated the separation of cancer cells from normal cells and provided the basis for a novel form of cancer therapy. His research led to the separation neuroblastoma cells from bone marrow using antibodies coupled with magnetic polymers in the form of microspheres.

Rembaum has received previous agency awards including the NASA Exceptional Scientific Achievement Medal in 1968 and again in 1984. His 1984 citation read in part, "In recognition of outstanding achievement in the field of polymer synthesis, and for his central role in the application of polymeric microspheres to important problems in biology and medicine."

Mars Observer Investigations Selected

As a first step towards returning to Mars exploration, NASA announced selection of 33 possible investigations for the Mars Observer mission scheduled for launch in 1990. The mission will place an unmanned U.S. spacecraft in orbit around the Red Planet in 1991 to conduct a 2-year study.

During the next 6 months (instrument accommodation phase), each proposed investigation will be evaluated for compatibility with the Mars Observer spacecraft and mission. Final selection then will take place and the investigations will be developed for the mission itself.

The Mars Observer mission, first in a new series of planetary observer missions to the inner solar system, will carry seven or eight instruments. Power for the spacecraft will be supplied by solar panels.

Carried into low-Earth orbit by the Space Shuttle, the spacecraft will be launched toward Mars by a solid fuel upper stage and placed into a near-polar orbit of 224 miles. The sun-synchronous, 117-minute orbit will allow the spacecraft instruments to make a complete global survey of the planet's surface and atmosphere about every 56 days. During the 2-year study, the spacecraft will track the planet's seasons and watch seasonal changes on the martian surface and in the atmosphere.

"This return to Mars is especially exciting because Mars is probably the only other planet in the solar system on which humans might reasonably expect to live some day," said Dr. William Quaide, Chief Scientist of NASA's Solar System Exploration Program. "It's also an exciting planet because in the past it may have been very Earthlike, whereas today it is a cold desert. We want to know how that came about."

Three experiments are expected to provide detailed information about the nature of martian surface material. They are the gamma ray spectrometer (GRS), the visual infrared mapping spectrometer (VIMS) and the thermal emission spectrometer (TES).

The trio of instruments will determine the chemical and mineral composition of the surface by measuring the gamma rays, visible light and infrared (heat) radiation emitted by the surface. The data will provide invaluable information on volatile materials (water ice and carbon dioxide), lava flows, rock types and surface weathering.

The martian atmosphere also is a major target for investigation. A pressure modulated infrared radiometer (PMIRR) will detect infrared radiation from the atmosphere to measure its chemical composition, pressure, temperature, water content and the presence of atmospheric dust. Other atmospheric measurements will be carried out by the GRS, VIMS and TES as well.

The spacecraft telecommunications system, along with the GRS and the VIMS, are primary instruments called facility instruments and are a special feature of the spacecraft's experiment package. Developed by NASA, the instruments can be modified to fly on future planetary missions. A team of scientists has been selected to operate each instrument and analyse the scientific results.

A second special feature is the selection of five scientists who will carry out wide-ranging interdisciplinary studies using data from several different instruments and experiments.

The Mars Observer radio communications system also will be used to map the atmospheric pressure and structure by noting how the atmosphere affects the radio transmission each time the spacecraft goes behind or comes out from behind the planet.

Three other experiments will focus on determining the shape of Mars and learning as much as possible about the interior of the planet. A magnetometer will be aboard to determine whether or not Mars has a weak magnetic field or perhaps, none at all.

The shape of the planet will be accurately measured by a radar altimeter to help determine details of the planet's surface, slopes of ancient river channels, exact depths of great canyons and the shapes of the huge martian volcanos.

Combined with measurements of the martian gravity field, the altimetry measurements also will help scientists probe the inside of Mars and help determine the strength of the martian crust.

It is uncertain if the mission will include a camera. NASA has selected an imaging experiment for evaluation during the instrument accommodation phase on the chance that the limited spacecraft resources and budget will accommodate it.

"We want very much to include an imaging system on the mission," said Quaide, "but the Mars Observer has been planned as a mission with limited resources — power, data rate and dollars — and we are not certain we can squeeze the camera in with all the other instruments which are considered more critical to the mission."

The camera, if selected, would provide synoptic images of global weather systems important for monitoring global dust storms on Mars. It also would give scientists the highest resolution images ever obtained from orbit of selected surface features.

Approved by Congress as a new start in Fiscal Year 1985, the Mars Observer mission will focus on specific goals of geoscience and atmospheric studies and is part of a new program of continued planetary exploration recommended in 1983 by the Solar System Exploration Committee, a part of the NASA Advisory Council.

Mission development and operations will be carried out by NASA's Jet Propulsion Laboratory, Pasadena, Calif. Project manager is William I. Purdy and project scientist is Dr. Arden Albee.

The Mars Observer program is part of NASA's Solar System Exploration Division under the direction of Dr. Geoffrey Briggs. Headquarters program manager is James Murphy and the program scientist is Dr. Bevan French. Program management is the responsibility of the Office of Space Science and Applications, NASA Headquarters, Washington, D.C.

Investigations Selected For The Instrument Accommodation Phase

Experiment Payload

Space Telecommunications System: Facility Instrument
Ultrastable Oscillator: Add-on to telecommunications system
Gamma Ray Spectrometer: Facility Instrument
Visual Infrared Mapping Spectrometer: Facility Instrument

Mario H. Acuna Goddard Space Flight Center	Magnetometer
Roger J. Phillips Southern Methodist University	Radar Altimeter
David E. Smith Goddard Space Flight Center	Radar Altimeter
Daniel J. McCleese Jet Propulsion Laboratory	Pressure Modulated Infrared Radiometer
Phillip R. Christensen Arizona State University	Thermal Emission Spectrometer
Micheal C. Malin Arizona State University	Mars Observer Camera

Facility Instruments

Gammay Ray Spectrometer

William V. Boynton Team Leader	University of Arizona

James R. Arnold	University of California, San Diego
Peter Englert	University of Cologne, Federal Republic of Germany
Albert E. Metzger	Jet Propulsion Laboratory
Robert E. Reedy	Los Alamos National Laboratory
Steven W. Squyers	Ames Research Center
Jacob I. Trombka	Goddard Space Flight Center
Heinrich Waenke	Max-Planck-Institute fur Chemie, Mainz, Fed. Republic of Germany

Visual Infrared Mapping Spectrometer

Laurence A. Soderblom Team Leader	U.S. Geological Survey
Bonnie J. Buratti	Jet Propulsion Laboratory
Roger N. Clark	U.S. Geological Survey
Larry W. Esposito	University of Colorado
Fraser P. Fanale	University of Hawaii
Hugh H. Kieffer	U.S. Geological Survey
Dennis L. Matson	Jet Propulsion Laboratory
Thomas B. McCord	University of Hawaii

Space Telecommunications System

G. Leonard Tyler Team Leader	Stanford University
Georges Balmino	BGI, GRGS, Toulouse, France
David P. Hinson	Stanford University
William L. Sjogren	Jet Propulsion Laboratory
David E. Smith	Goddard Space Flight Center
Richard Woo	Jet Propulsion Laboratory

Interdisciplinary Scientists

Michael H. Carr U.S. Geological Survey	Geosciences
James B. Pollack Ames Research Center	Atmospheres/ Climatology
Andrew P. Ingersoll California Institute of Technology	Polar Atmospheric Sciences
Bruce M. Jakosky University of Colorado	Surface Atmosphere Interactions
Raymond E. Arvidson Washington University, St. Louis	Data Management/ Archiving

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Good Sleep Strategy May Reduce Pilot Fatigue

Flight crews could substantially reduce the effects of jet lag after flying distances eastward by not going to sleep immediately after arriving, according to a study released early this year by an international group of scientists, physicians and airlines personnel.

The study, coordinated by Ames Research Center, Mountain View, Calif., was supported by scientists from the Institute for Aerospace Medicine in Cologne, West Germany, the Royal Air Force Institute of Aviation Medicine in Farnborough, England, the Civil Aviation Authority in London, the Japan Air Lines Flight crew Medical Service in Tokyo and the Stanford University School of Medicine in California.

According to data compiled by NASA's Aviation Safety Reporting System — a system set up to receive anonymous reports from flight crews on air traffic incidents — there have been 261 reports, between July 1980 and August 1984, that listed fatigue as a contributing factor to the incident.

In 1983, the United Kingdom established a similar reporting system and in its first 18 months of operation, received 52 reports citing problems of fatigue.

Foregoing or minimizing sleep right after arrival and extending the subsequent awake period during the local day, helps to ensure that the night sleep will be nearer to normal duration. The findings suggest that by using this sleep strategy, the poor sleep which normally occurs should be minimized, thereby reducing sleepiness during the subsequent long return flight.

Scientists continue to analyze the data to understand the effects of other variables, including age and personality characteristics on layover sleep quality.

The researchers, with the support and cooperation of our international airlines and their flight crews — British Airways, Japan Air Lines, Lufthansa, and Pan American

World Airways — took objective and subjective measures of sleep quantity and quality. The data were obtained from volunteer pilots and flight engineers who flew trips across seven to eight time zones between their home bases and Tokyo, San Francisco, London and Frankfurt.

Instead of spending their layover nights in hotels, flight crews went to specially equipped sleep laboratories in the destination cities. Scientists placed electrodes on the crews to record brain activity. They also measured sleep and waking patterns. From the data, the scientists determined the crews' quality and quantity of sleep, their sleepiness the following day, and their sleepiness prior to reporting for duty to fly.

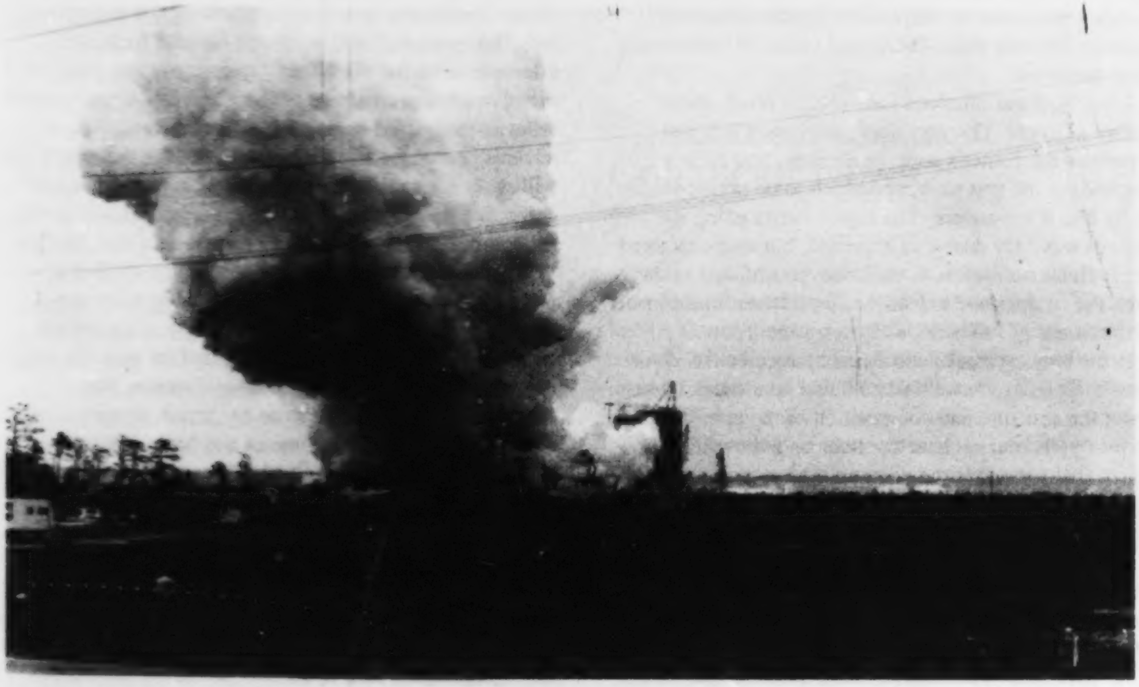
The scientists used the data to determine the relative effectiveness of different "sleep strategies" such as napping or sleeping according to home time, e.g. California time, instead of local time, e.g. London time, assuming a San Francisco to London flight.

While most of the 56 volunteers obtained adequate sleep, researchers noted major differences in sleep quality between westward and eastward flights, an effect that is well-known to many long distance travelers. Following westward flights, crew members clearly experienced less difficulty obtaining sleep during layovers compared with eastward flights. In fact, following westward flights, most subjects fell asleep faster, reported better quality sleep, and slept as long as they did when "baseline" sleep recordings were taken in their home cities.

Sleep patterns were more variable and fragmented after eastward flights than after westward flights across an equivalent number of time zones. Flight crews often broke up one long sleep period into two or more sleep periods. The poor quality of this sleep was reflected in increased levels of day time sleepiness the following day.

Most crew members took naps in the afternoon prior to reporting for duty for the return flight — a strategy which appears to prepare them well for the upcoming eastward night flight.

This study was limited to examining sleep quality during initial layovers. Follow-on studies are planned to extend the findings to multiple layover flight schedules typically flown by international flight crews.



20th Anniversary Of First Test Firing Celebrated

Past and present employees of the NASA National Space Technology Laboratories celebrated the twentieth anniversary of the first test firing at NSTL April 23.

On that date in 1966, a 15-second static firing of the ground test version of the Saturn V second stage was successfully conducted. That historic first test paved the way for the testing of all Saturn V first and second stages used in the Apollo manned lunar landing and Skylab programs from 1966 to 1970. The current Space Shuttle main engine testing has been under way since 1975.

From the Congressional Record

Representative Wyche Fowler, Jr. provided the following remarks on the next step in cometary study:

Recently, the world witnessed its first close encounter with that famed cosmic traveler known as Halley's Comet. Returning again to our region of the solar system — after 30 or more previous visits and the first since 1910 — Halley's Comet was met this time by an international armada of robot explorers.

These explorers named Suisei, Sakigake, Vega 1 and 2, and Giotto completed stunningly successful missions. The five automated spacecraft are the products of years of planning, research, and development. They sprang from impressively diverse origins — Suisei and Sakigake from Japan, the twin Vega probes from the Soviet Union, and the Giotto spacecraft from Europe. We salute the responsible governments and agencies for their skill, daring and vision in undertaking these missions.

Already, these missions have told us much about Halley's Comet. The very dark, dirty snowball that composes the comet's core, or nucleus, was photographed for the first time, appearing to be potato-shaped, 15 by 6 to 8 kilometers. The region surrounding the nucleus was very dusty, as expected, but also contained larger chunks of debris as well. Geysers of dust erupt from the nucleus and extend, in some cases, to distances of thousands of miles.

In the coming weeks and months, as scientists continue their analysis, we will no doubt hear much more about the structure and composition of the comet and its various parts: the nucleus; the tenuous atmosphere, or coma, that surrounds the core; and, of course, the luminous tail that most of us associate with Halley's Comet and other comets.

The international effort in space and here on Earth will result in the most thorough characterization, to date, of any comet. But the results, no matter how thorough, will be limited by their context — that is, by the nature of quick spacecraft flybys during only one brief period of the comet's evolution.

The findings of the Halley spacecraft armada will lay a basis for more detailed explorations. At present, NASA is designing just such an exploration, an actual rendezvous in which an American spacecraft could meet a comet and fly in formation with it for 3 years.

The mission is called the Comet Rendezvous Asteroid Flyby (CRAF). As its name states the CRAF mission would also provide an opportunity for closeup study of another mysterious class of body, the asteroid.

Under plans being developed at NASA's Jet Propulsion Laboratory, Pasadena, Calif., a new spacecraft known as the Mariner Mark II would be launched in September 1992 from a space shuttle and upperstage rocket.

Nine months later, in June 1993, the spacecraft would fly past the asteroid Malautra — and conduct a historic first encounter with one of the small rocky bodies of the asteroid family. A swing back toward, and then past, our Earth would give the Mariner Mark II a needed "gravity assist" toward its encounter with the asteroid Hestia in January 1995.

The spacecraft would continue on to the comet Tempel 2 and rendezvous with it in December 1996 — fully 1,000 days before the comet reaches its perihelion, or closest approach to the sun, and begins its most active phase. Unlike the recent flyby missions, CRAF would study its target comet over a long duration — before and during perihelion passage and perhaps beyond. This allows the diverse time varying phenomenon to be studied. The spacecraft will study the nucleus from a 50-kilometer orbit for more than 1 year providing 50 centimeter resolution coverage of the whole body and infrared reflectance spectral maps with 10 meter resolution. A nucleus penetrator will be ejected from the spacecraft that will study the subsurface material. This penetrator will determine the physical strength, temperature, and chemical composition — up to 20 elements — of that location.

The coma, dust tail, and ion tail will be studied at perhaps 5,000 kilometers and periodically from very close — possibly 100 kilometers. These close periods will allow dust samples to be collected for analysis when the spacecraft is back out at a safer distance. The spacecraft will also perform an excursion down the tail to approximately 75,000 kilometer and back. These coma and tail studies will allow both time and spatial varying phenomena to be studied. The solar wind and its interaction with all aspects of the comet will be extensively studied.

Although the flyby missions of 1985 and 1986 revealed new coma and tail information about Giacobini-Zinner and Halley, only limited characteristics of the relatively tiny nucleus could be ascertained during the brief encounters. Obtaining more detailed data on the chemical and physical properties of a comet's nucleus remains for the future.

Understanding the all important nucleus comes with the next step — a mission in which the spacecraft can travel along with the comet, observe it at close range from a variety of vantage points and watch its activity grow and diminish as the comet first approaches and then speeds away from the sun. Better-defined coma and tail measurements also will be produced with the time-varying multiple-location observation of a rendezvous mission.

An ambitious and important mission such as this can be accomplished with available technology and at relatively low cost. Even as we salute our international colleagues for their successes of the past several days, we must begin to look ahead to taking this next step in cometary study.

Disease Mapping In Africa

A scientist at the Goddard Space Flight Center, Greenbelt, Md., has developed a project which could reduce disease in Africa and improve the health of humans and livestock on that continent. The project uses radar image analysis to map insect breeding grounds and disease transmission areas.

Applications of this project also could be applied to research in drought and famine relief.

Marc L. Imhoff, Goddard principal project investigator, has described the program as a marriage between high technology, mapping and epidemiology.

"Our goal," he explained, "is to demonstrate that disease control can be greatly enhanced through routine remote sensing."

The project is scheduled to run in 1987 during the African rainy season. The breeding habitats for mosquitos are the primary targets. Mosquitos in Africa can transmit many diseases and four major diseases have been selected for the study: Rift Valley fever, malaria, Congo-Crimean hemorrhagic fever and dengue fever.

Imhoff flew a similar project aboard the Space Shuttle Imaging Radar B-2 program in 1984 and demonstrated that radar can penetrate jungle vegetation and expose areas of ponded water below.

"Radar has no human sensory counterpart," he explained. "It can penetrate cloud cover and to a certain extent vegetation growth and also detect soil moisture."

For this project, the radar images will be shot from aircraft. Because of differences in the aircraft system, the images will show land features in greater detail than those acquired from the shuttle.

The Goddard scientist is responsible for coordinating the expedition to Africa, collecting the radar data and establishing a ground truth (verifying a small area in order to classify a larger one) for the regions to be studied. The United States Army Medical Research Institute of Infectious Diseases (USAMRIID) is sponsoring the project and will act as co-investigators with NASA. USAMRIID also will help with diplomatic liaison activities between Goddard and the nations involved.

For researchers to translate the radar images into disease maps, the land features that support infected insect populations must be identified.

Insects breed in areas known as "dambos." During the African rainy season these areas are created when swollen streams flood the surrounding grasslands. Once filled with stagnant water, these dambos become ideal breeding grounds for insect populations.

Imhoff, USAMRIID and an African team of scientists will simulate these conditions and establish the relationship between soil moisture and insect breeding. The research team will pump water out of streams and grow a crop of bugs in man-made dambos. The bugs will be captured, counted and analyzed to determine the amount of soil moisture needed for specific diseases to flourish.

The knowledge gained from these simulations will play an important role in establishing a ground truth. Radar images of small infested areas will be used to classify pictures of larger regions.

Contractor News

NASA's Johnson Space Center, Houston, selected **Hamilton Standard of United Technologies,** Windsor Locks, Connecticut for negotiations leading to award of a cost-plus-fixed-fee contract for a Regenerative Environmental Control and Life Support System (ECLSS) Technology Demonstrator.

Closed-loop life support systems are envisioned for the Space Station planned for orbital operations in the mid-1990s.

Valued at approximately $7 million, the contract would include conceptual design of ECLSS subsystem setups, subsystem level testing at JSC; integration, assembly and checkout testing of a set of subsystems, test preparation and unmanned demonstration testing, and support during manned testing performed by JSC. Hamilton Standard's work would last about 38 months.

NASA's Ames Research Center, Mountain View, Calif., awarded **General Electric Company, Space System Division,** Sunnyvale, Calif., a contract modification for technical integration and support services. The work will be performed on a cost-plus-award-fee basis for the Numerical Aerodynamic Simulation (NAS) program.

The estimated value of this 28-month modification is approximately $19 million. Total value of General Electric Company's 5-year contract is estimated to be $29 million. The modification is an extension of services presently being performed at the Ames Research Center.

General Electric Company will provide the necessary management, personnel, equipment and facilities required to accomplish the technical integration of the separate elements of the NAS program into an operational capability.

NASA's NAS program is planned to provide the world's most powerful large-scale, high-speed processor system. In addition to its important advantages for aircraft design, NAS represents a major national facility in such research areas as aerothermodynamics, computational chemistry, atmospheric modeling and other computationally intensive scientific applications.

Did You Know?

Seven recently discovered asteroids were named for the seven astronauts who died in the explosion of the space shuttle Challenger.

The asteroids, which were discovered by the Lowell Observatory in Flagstaff Ariz., from 1980 to 1984, are believed to be from 5 to 10 miles in diameter.

The Central Bureau for Astronomical Telegrams of the International Astronomical Union yesterday notified observatories around the world of the new names. The bureau is at the Smithsonian Astrophysical Observatory in Cambridge, Mass.

According to Dr. Brian G. Marsden, its director, most of the seven asteroids are orbiting the sun in the asteroid belt between the orbits Mars and Jupiter. However, one, designated McAuliffe, is an Amor type asteroid that comes well inside the orbit of Mars in its closest approaches to the sun.

Dr. Theodore Bowell, director of the Lowell Observatory, said that it was named for the teacher-astronaut Christa McAuliffe because "it was the most interesting and we felt she should warrant special attention."

Another, Jarvis, belongs to the Hungaria class whose orbits are inclined 20 to 25 degrees to the orbits of the planets and of most asteroids. Asteroid Smith is the most distant of the seven and hence was most difficult to identify.

The asteroids were assigned a sequence of seven consecutive number designations on Dec. 27. Dr. Marsden subsequently proposed that they be named for the seven astronauts who died Jan. 28. This has been approved by the Minor Planet Names Committee of the International Astronomical Union of which Dr. Marsden is a member.

Shortly after the shuttle disaster, the Soviet Union, which has sent several missions to Venus, announced that it would name two craters on that planet for the women who died in the explosion. Honoring only the women, the Russians said, was appropriate since in mythology Venus was the goddess of love and beauty.

A Marshall-developed system will be used to detect eye problems in children in more than 1,000 child care centers across the United States, according to Ismail Akbay, director of the Technology Utilization Office, NASA's Marshall Space Flight Center, Huntsville, Ala.

The system, called the Photorefractor Ocular Screening System, is being manufactured by Medical Sciences Corporation of Wedowee, Ala., a participant in the development of the system. Development of the system began in 1979.

Medical Sciences Corporation has signed a contract with Kinder-Care Learning Center, Inc., to provide vision screening for children in the 1,025 Kinder-Care Centers across the United States. The new contract is a significant development in the commercial use of this aerospace technology transfer.

The system is an economical, highly reliable screening device that uses a 35mm camera body, a 500mm telemacro lens and an electronic flash to make color images of both eyes simultaneously. The images are then analyzed to compare the retinal relfexes between the eyes of an individual.

The system is capable of testing the human eye for refractive error and obstruction in the cornea or lens. Occular alignment problems are detected by photographing both eyes simultaneously. The color images of each eye are analyzed for alignment defects and differences.

Use of color film is important to detect refractive errors, to determine the difference in refractive error between two eyes, to detect lens obstructions, and to determine eye alignment defects.

Independent tests conducted in 1982 by the Smith-Kettlewell Eye Research Foundation in San Francisco rated the accuracy of a prototype system at 88 percent. An advanced version of the system has been authorized for use by the Food and Drug Administration and will be used at the Kinder-Care centers. The new system has an even better accuracy.

A NASA space collection, consisting of thousands of educational materials, is now easily accessible for the more than 5,000 educators in Upper Michigan and Northeastern Wisconsin.

On April 14, 1986, NASA's Lewis Research Center, Cleveland, Ohio, opened a new Regional Teacher Resource Room at Northern Michigan University, Marquette, Michigan.

The new facility, located in the University Library Building, will serve as a resource site for elementary through university level teachers and will offer selected NASA films, slides and printed information on this country's aerospace achievements.

Establishment of the Regional Teacher Resource Room is part of Operation Liftoff, a NASA educational program announced by President Reagan in 1984. The purpose of Operation Liftoff is to encourage pupils in the nation's 76,000 elementary schools to take greater interest in math and science.

NASA and the Astronauts Memorial Foundation, Inc. will build a memorial at the Kennedy Space Center, Fla., dedicated to astronauts who have lost their lives while flying, training or awaiting assignment to fly for the space agency.

NASA will provide a site for the memorial at the Kennedy Space Center, while the foundation will raise funds for the design, construction and perpetual care of the memorial. U.S. Sen. Jake Garn and U.S. Rep. Bill Nelson, both of whom have flown on the Space Shuttle, are co-chairing national fundraising efforts for the private, non-profit foundation, based in Cape Canaveral, Fla.

Once the memorial is completed, education will become the focus of the foundation's efforts, according to the group's organizers. A scholarship fund will be established to support students pursuing careers in the fields of teaching, engineering and science.

The memorial will honor: the Space Shuttle Challenger crew, including Francis (Dick) Scobee, Michael Smith, Judith Resnik, Ronald McNair, Ellison Onizuka, Christa McAuliffe and Gregory Jarvis; the Apollo crew who died when a fire swept their spacecraft during a launch simulation in 1967, including Virgil (Gus) Grissom, Edward H. White II and Roger Chaffee; Gemini IX astronauts Charles Bassett and Elliott See, who were killed in a crash of their T-38 trainer aircraft in 1966; Theodore Freeman, who died in a T-38 accident in 1964; Clifton Williams, who also died in a T-38 accident in 1967, and Edward Givens, who was killed in an automobile accident in 1967.

Contributions to the Astronauts Memorial Foundation, Inc., may be addressed to:

Astro Memorial Foundation Inc.
P.O. Box 628003
Orlando, FL
32862-8003

Mr. Douglas Broome, Chief of Flight Program in the Astrophysics Division of the Office of Space Science and Applications, Washington, D.C., recently completed the Senior Executive Fellows Program at the John F. Kennedy School of Government, Harvard University. He was selected for this competitive fellowship program after working at NASA a number of years in a variety of positions.

Mr. Broome's experience as a Harvard Fellow has enabled him to better understand the policy and implementation issues facing senior government managers. His expertise there helped him be more confident and competent in implementing NASA's goals and objectives.

The Third Annual NASA/Contractors Conference, sponsored by NASA Headquarters and hosted by the NASA Ames Research Center, Moffett Field, Calif., took place May 7 and 8, 1986 in Palo Alto, California. The Conference theme, "What Works, What Doesn't Work," provided a forum for about 350 senior NASA and aerospace industry officials to share experiences in productivity improvement and quality enhancement.

The conference was composed of panels of representatives from NASA Centers as well as aerospace organizations who have active interests in formalizing the process to improve quality and productivity.

In addition to all the NASA installations being represented, over 300 contractors representing over 150 aerospace profit centers were in attendance.

NASA/Goddard's Wallops Flight Facility, Wallops Island, Va., will begin providing support for scientific satellites during April 1986, a new responsibility stemming from the transfer of all orbital satellite tracking/telemetry operations from the Goddard Space Flight Center tracking station, Greenbelt, Md. to Wallops.

The orbital operations being transfered are in support of: International Ultraviolet Explorer Satellite (IUE), April 2; Inter-planetary Monitoring Platform Satellite (IMP-7), April 7; Nimbus-7 Meteorological Research Satellite, April 14; and the Cosmic Background Explorer (COBE) spacecraft, tentatively set for launch in early or mid-1988.

To handle the additional workload, existing telemetry systems at Wallops were supplemented with equipment from tracking stations around the world that are being phased out. A new communications system will be used to transmit the data from Wallops to the project control centers located at Greenbelt.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Bowling Ball Spotting

Ebonite International, in Hopkinsville, Kentucky, has been making bowling balls since 1907 and has become one of the leading manufacturers in the bowling equipment industry with a reputation for innovation. A recent innovation, introduced to the production line in 1984, is what the company calls the most accurate weighing and spotting system in operation. Called Exactatron, it was developed by Ebonite engineers with the help of technological information provided by NASA.

The weighing/spotting system is used to determine precisely the top dead center point of a bowling ball. The ball is "top weighted" during the manufacturing process, meaning that an area near the top is more dense — or heavier — than the rest of the ball. Top weight influences the spinning or hooking action of the ball, thus is important to professional bowlers.

To drill for top weighting, it is necessary to know exactly — within a small fraction of an inch — the top dead center spot. This was formerly accomplished at Ebonite by mechanical measurement, but the company felt it would be possible to develop a more precise system with modern technology. Ebonite outlined the problem to NASA and requested technological information that might be pertinent to development of a more advanced system. NASA conducted a computer search and responded by supplying three technical reports on work performed at NASA's Jet Propulsion Laboratory (JPL). One concerned a procedure and a fixture for determining with high accuracy the mass and center of mass of an object, regardless of its shape; the technology was originally developed for the Voyager interplanetary spacecraft but is applicable to many devices that require precise balance. The other reports described JPL research on techniques and apparatus for measuring the viscosities of liquids, which are not always known or easily measured. These reports provided an informational base for Ebonite's development of the Exactratron system for exact spotting of the drilling point for top weighting.

At left, a ball is mounted on a circular ring then lowered into a cylindrical basin containing a solution of calcium bromide, a liquid that has the proper specific gravity to allow the ball to float. The floating ball rotates momentarily as the heavy portion of the ball settles to the bottom of the calcium bromide bath. When the ball finds equilibrium and stops rotating, a plunger mechanism spots the center point and the marked ball is elevated and removed from the system.

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* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

*U.S. GOVERNMENT PRINTING OFFICE: 1986-491-575:20009

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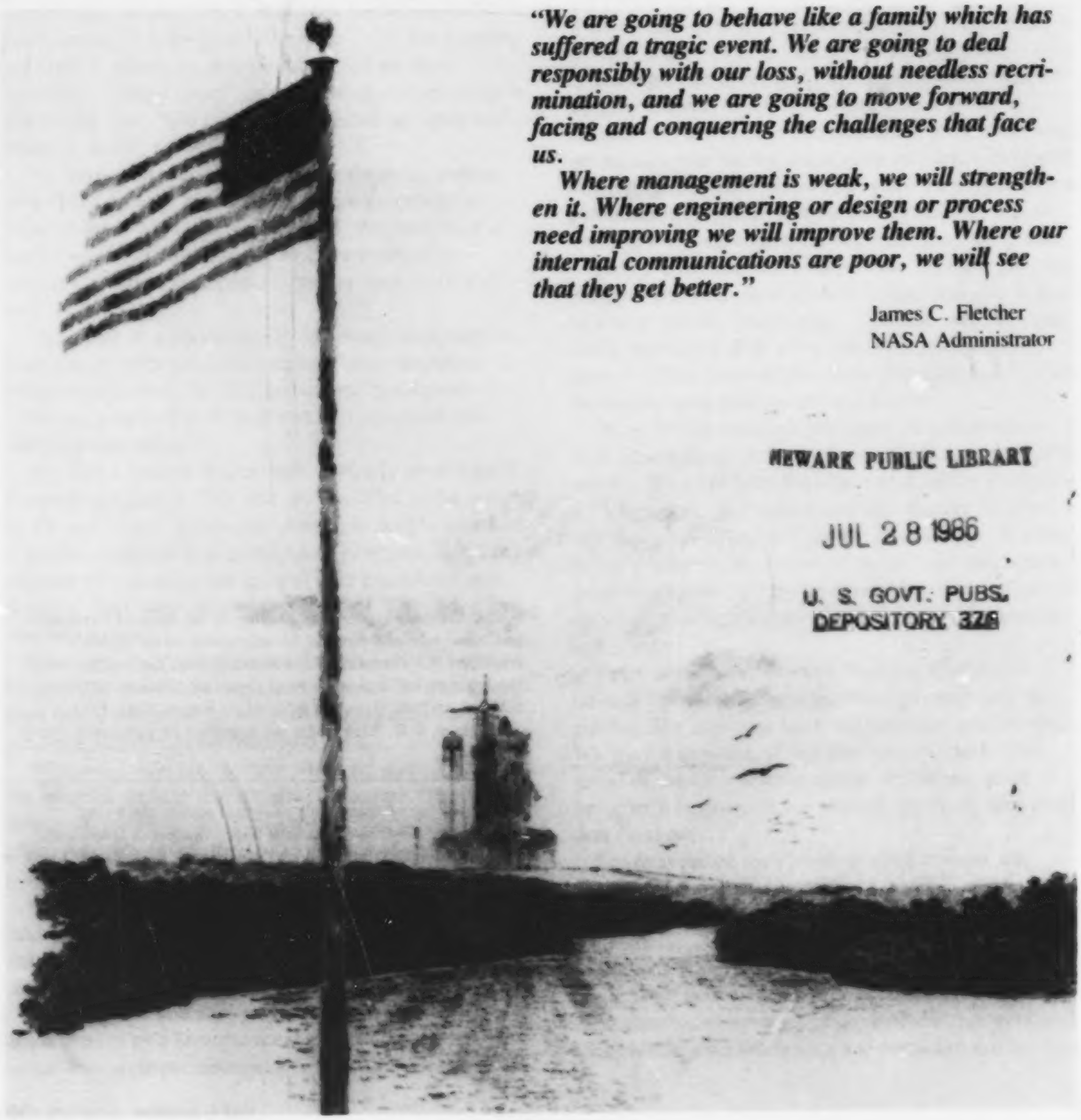
NASA Activities

National
Aeronautics and
Space
Administration

June-July 1986
Vol. 17, No. 6 & 7

Special Edition



"We are going to behave like a family which has suffered a tragic event. We are going to deal responsibly with our loss, without needless recrimination, and we are going to move forward, facing and conquering the challenges that face us.

Where management is weak, we will strengthen it. Where engineering or design or process need improving we will improve them. Where our internal communications are poor, we will see that they get better."

James C. Fletcher
NASA Administrator

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A pencil drawing entitled, "Morning of the Launch at KSC", done on location, shows the Shuttle Orbiter Discovery on Pad 39A waiting to lift-off on April 12, 1985.

Contents

From The Administrator 3
From The Office Of Space Flight 4
Civilian Space Goals For 21st Century America 6
Lunar Soil Produces High Grade Concrete Material 9
Dr. Chang-Diaz Selected For New Medal 10
Space Science To The Crime Lab 10
From The Congressional Record 11
NASA's Quality and Productivity Enhancement Program 13
Discovered Asteroids Could Provide For Future Space Mining 14
NASA Space Technology Enhances Disease Detection 15
New Asteroid/Comet Hazard Studies 16
Did You Know? 16
Contractor News 19
Another Dividend From Air And Space 20

NASA Activities is published monthly by the National Aeronautics and Space Administration for the information of the agency's employees. Contributions and recommendations are solicited from Headquarters and field centers and should be addressed to Editor, NASA Activities, News and Information Branch, Code LFD-2, Washington, D.C. 20546. Material submitted for publication cannot be returned.

Distributed free of charge only to current agency employees. Available by subscription from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Check or money order should be made payable to Superintendent of Documents, GPO. Subscription rates are $23.00/year, domestic; $28.75/year, foreign.

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From the Administrator

The following is the statement NASA Administrator James C. Fletcher presented to the nation upon receiving the Rogers Commission Report June 9, 1986.

After the Challenger accident, President Reagan told our shocked nation, "The future does not belong to the faint-hearted. It belongs to the brave. . . . "The Challenger crew is pulling us into the future and we must continue to follow them." In words of special meaning to NASA, he said, "We must pick ourselves up again and press on despite the pain."

We have been pressing on, despite the pain, seeking answers to difficult questions, beginning carefully to make changes where they are needed. We have been at work, yet like all Americans, we have awaited the Rogers Commission Report, hoping to learn from it as well.

The report of a Presidentially-appointed, independent body carries with it special status and the compelling obligations to study its conclusions with great care.

We are prepared to do that with an open mind and without reservations.

For over a quarter of a century, certainly since John F. Kennedy pledged in 1961 that we would be on the moon by the end of that decade, the American people have had a special relationship with our space program. They have cheered with us and wept tears of both excitement and sadness. They have seen near perfection. They have seen absolute tragedy.

Certainly, many people were skeptical of that promise to go to the moon. But our space pioneers — who gave their hearts and souls, as they continue to do, to the program—made that promise come true.

Who will forget the moment when we landed men on the moon? People in this country and around the world wept with joy as we accomplished the seemingly impossible. America never stood taller. Heads of state and common folks both cheered.

Who will forget the space walks and the experiments and the photographs of a universe we understand better for the genius and accomplishments of NASA and its associates.

Recently and unfortunately, those positive images were blurred by a horrible accident. Confidence which arose from an unprecedented string of successes was crushed with the Challenger tragedy. Early tears of joy were replaced with bitter tears as people wept with sadness and some anger when we suffered the loss of seven brave astronauts.

Today, the Rogers Commission has issued its report on the event which has already received widespread and deserved coverage in the media and deep and serious consideration within this agency. Its conclusions, no matter how tough, how pointed, how questioning they may be, are not unexpected and certainly not entirely undeserved.

We — and I mean all of us at NASA — will be studying the Commission's judgments and recommendations carefully and thoroughly during the days ahead. We will be offering to the President and to all Americans our specific responses in an orderly and timely way.

The report deserves that kind of thoughtful treatment. To give it less is to insult a distinguished group of citizens who are serious and concerned about what went wrong . . . who have spent several months dealing with difficult questions. It was a task which they undertook as public servants whose sole purpose, I believe, was to seek the truth and to help our national space program.

They are determined, as is NASA, to ensure that this program will become as good as it ever was and as good as it ever can be. Their report, I am also sure, was not and is not intended to sound the death knell of this agency, of the space explorations that distinctively mark the ingenuity of this century and the next.

We at NASA welcome the report. It was obviously time for a serious, thoughtful, constructive review of the agency. We have been the object of America's respect for a long time. We cannot take this respect for granted in today's environment. Like an old marriage, this relationship between the American people and their space program requires honesty and periodic review. That can only lead to a better understanding and a refreshing of that loyalty.

Every administration from President Eisenhower through President Reagan has been generous and supportive. The Congress has been interested and involved. We have responded, giving this country much to be proud of, much to stir the simple and intense pride of being an American, as we worked openly through good times and bad.

I have accepted the President's call to make this agency as vibrant and careful as it can be, to help it earn the respect it deserves and the excellence that has been its hallmark.

We will achieve those goals in a more restrictive atmosphere than we have been accustomed to. Like other departments and agencies of government, we work under the severe budget limitations and restrictions of our time.

And that is proper. Unlike other agencies, our failures are immediately visible, our failures endanger lives and property, our latitude for error extremely narrow. But we cannot and will not sacrifice safety concerns to budget limitations.

We are going to behave like a family which has suffered a tragic event. We are going to deal responsibly with our loss, without needless recrimination, and we are going to move forward, facing and conquering the challenges that face us.

Where management is weak, we will strengthen it. Where engineering or design or process need improving, we will improve them. Where our internal communications are poor, we will see that they get better.

This is an agency whose excellence and commitment to new frontiers drew to it seven exceptional Americans. Our response must be to overcome our errors, not to quit, to stop, or to cave in. To stumble now in hesitation is to mock their commitment to reaching for distant horizons, and their willingness to take a chance in seeking knowledge and understanding.

Let me conclude by repeating my thanks to the Rogers Commission, for undertaking a tough job and working commendably through long weeks toward their conclusions. Their work, I give you my sacred pledge, will not have been in vain. And I think I speak for all NASA employees when I say that. We are in a very special way, an agency with a mission determined, now to regain our honor in its fullness. This is a day of tension for us, but it is also a day of resolve, a time of beginning, and a time of rededication.

Thank you.

From the Office of Space Flight

The Associate Administrator of the Office of Space Flight, Rear Admiral Richard Truly, presented this statement before the Committee on Science and Technology House of Representatives, Washington, D.C.

Mr. Chairman and Distinguished Members of the Committee:

During the months since I returned to duty with NASA following the tragic loss of Challenger, I, along with my entire organization, have spent many hours in support of the Rogers Commission. We have done our best to assist them in the conduct of their investigation, and I have reviewed the Commission report to the President. I find it to be extremely thorough and comprehensive. I am in general agreement with all findings and recommendations and am pleased to say that because of our close association with their work, I have been able to anticipate the corrective actions required to safely return the Space Shuttle to flight. These corrective actions were initiated by my memorandum of March 24, 1986, and a subsequent memorandum by Mr. Aldrich on March 28, 1986, which directed the Shuttle program to undertake this task. These memoranda are included as enslosures to this statement. I would now like to briefly take each of the Commission's recommendations, and provide you with a summary status of my work.

SOLID ROCKET MOTOR (SRM) DESIGN

On March 24, I directed Marshall Space Flight Center (MSFC) to form a SRM joint redesign team to include participation from MSFC and other NASA centers as well as individuals from outside NASA. This team was formed with Mr. John Thomas as its leader. The team includes personnel from JSC, KSC, LaRC, industry, and the astronaut office. In addition, an expert advisory panel was appointed to assist the redesign team. This panel includes 12 people of whom half are from industry. As a result of an early suggestion from the Commission, Dr. Fletcher requested the National Research Council (NRC) to appoint an independent oversight committee to review the activities of the redesign team. The NRC has agreed and the members of the committee have recently been announced.

The redesign team is currently pursuing several options for redesign of the joint with a tentative date for the Preliminary Design Review this summer. Let me assure you that safety, not schedule, is and will continue to be our primary concern. We will not return to flight status without a safe, tested and certified design. We welcome the assistance of the NRC oversight committee, and I intend to work very closely with them, just as I did with the Rogers Commission, to assure full and complete consideration of their recommendations.

SHUTTLE MANAGEMENT STRUCTURE

The Presidential Commission recommended a thorough review of the Shuttle program structure. On March 24, I initiated detailed review of the NSTS management structure to determine those changes both technically and philosophically that are necessary in order to make the STS a more effective organization. I wholeheartedly support the recommendations to reassess and redefine the responsibilities of the STS Program Manager and to ensure that he has the specific type of authority suggested in the commission report. I intend to reevaluate the Level I/II/III program management concept and to implement any changes necessary to strengthen that structure and to reduce the potential for conflict between the program organization and the institution both at Headquarters and in the field. Utilization of present and former members of the astronaut office will be given proper consideration in that process. I concur completely in the concept of a Shuttle Safety Panel reporting to me and will initiate action to implement this concept and personally leave my door open to them as we move forward.

As you know, Dr. Fletcher has asked General Phillips to review all aspects of NASA program management and this internal Shuttle overview will be accomplished in close coordination with General Phillips.

CRITICAL ITEMS REVIEW AND HAZARD ANALYSIS

In response to my direction, on March 28 Mr. Aldrich initiated a review of all items on the Critical Items List. As a first step, all CRIT 1 and 1R item waivers were cancelled and NASA is in the process of a complete review and reevaluation activity for all items on the list. Those CRIT 1 and 1R items which are not revalidated by the review must be redesigned, certified, and qualified for flight. All other CRIT 2 and 3 items are being reviewed to ensure proper categorization. This reveiw has been under way for some time.

SAFETY ORGANIZATION

Although Safety, Reliability, and Quality Assurance (S, R & QA) is not my direct responsibility, I am vitally concerned about this activity and pledge to work closely and do what I can to strengthen this most important element of our program. The NSTS program does perform many of the activities that relate to program safety and all are under thorough review at this time. Each person in the agency has an obligation to put safety first and this will be reiterated many times over the next months. Within the STS program I intend to ensure that the management structure and its system is modified so that reporting requirements are clearly defined and rigidly enforced, and management at all levels is informed of all significant issues and their current status.

IMPROVED COMMUNICATIONS

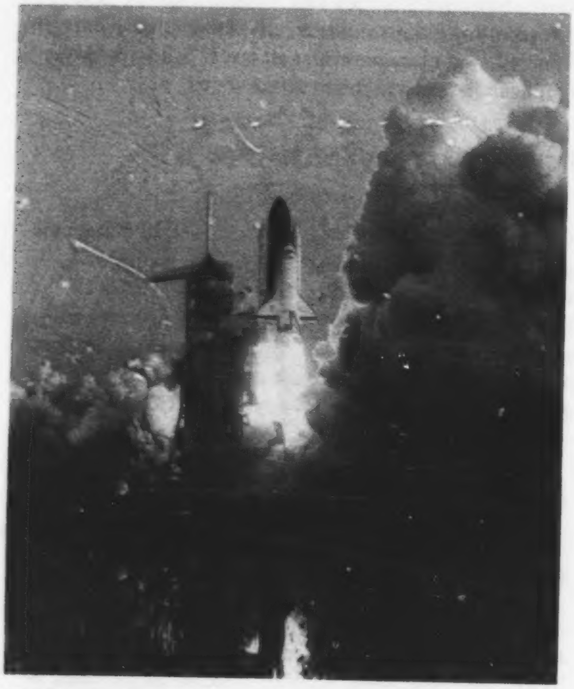
I think this may be the most important part of the Commission's work, and that it applies to all our people and organizations. As part of my overall review and restructuring of the management system for the STS, internal and external communication will be given primary consideration. This activity will include MSFC and all other shuttle program organizations and will ensure that the specific recommendations of the Commission will be considered.

LANDING SAFETY

Landing safety has been a significant concern of the program from the days of our approach and landing tests of the "ENTERPRISE." All shuttle hardware and systems are undergoing design reviews to insure compliance with the specifications and concern for safety. The tire, brakes, and nose wheel steering systems are included in this activity, and funding for a new carbon brakes system has been approved. Specifically tire and brake testing is currently scheduled for this summer. KSC runway surface testing had been underway for sometime prior to the accident and is continuing. Better methods of weather forecasting and weather related support are being evaluated at this time. The potential for increased landings at Edwards Air Force Base was recognized prior to the accident and will be a dominant factor in our schedule as we return to flight status. Dual ferry capability has been a desire for some time and will be thoroughly considered during the upcoming months.

LAUNCH ABORT AND CREW ESCAPE

On April 7, Mr. Aldrich initiated a STS Crew Egress and Escape review. The scope of this analysis includes egress and escape capabilities from launch through landing and will provide analyses, concepts, feasibility assessments, cost and schedules for pad abort, bailout, ejection systems, water landings, and powered flight separation. In conjunction with this activity we are also reviewing all launch abort rules and philosophy to ensure that launch commit criteria, flight rules, range safety systems and procedures, landing aids, runway configurations and lengths, performance versus abort exposure, abort and end of mission landing weights, runway surfaces, and other landing related capabilities provide the proper margin of safety to the vehicle and crew.



FLIGHT RATE

NASA is actively participating with other governmental agencies in a comprehensive review of the nations ability to assure access to space. I concur with the mixed fleet concept to avoid reliance on a single vehicle. Development of a NASA flight rate which maximizes safety dictates that we fly at a rate consistent with our resources and I intend to develop a schedule which achieves such a rate. Our payload assignment policy and flight manifesting are under my personal review, to assure both that our rules are clear and that we have the discipline to reduce the late changes which cause such an upheaval in the flight planning process.

MAINTENANCE SAFEGUARDS

The STS maintenance philosophy and its implementation, particularly with regard to our spares inventory, is currently under review since shortly following the accident. The results of this activity will be integrated with the results of our S, R.,& QA review to develop an overall plan for vehicle processing, maintenance, trend analysis, structural inspections, and spare parts.

Mr. Chairman, I came to this job in the weeks following this tragic accident with the resolve and duty to assist the Presidential Commission in finding the cause. The Commission has done their work; I embrace their report and believe that I have set into motion the initial steps to return the Space Shuttle to safe and effective flight. Their report is a roadmap for me, and I intend to use it as my mandate for action. Thank you for the opportunity to testify before your Committee today, for NASA needs your support and guidance as our Nation returns to space flight.

Civilian Space Goals for 21st Century America

The Presidentially-appointed National Commission on Space released its year-long study of a bold civilian space program for 21st century America. The Commission calls upon the Nation to establish a step-by-step effort to create a "Highway to Space" and a "Bridge between Worlds" which open the inner Solar System for scientific inquiry, exploration and enterprise and leads to the first human outposts on the Moon by 2005 and Mars by 2015.

As stated in its report, the 15 members of the Commission want the United States . . .

> "To lead the exploration and development of the space frontier, advancing science, technology, and enterprise, and building institutions and systems that make accessible vast new resources and support human settlements beyond Earth orbit, from the highlands of the Moon to the plains of Mars."

As mandated by Congress, the Commission undertook a prospective look at U.S. space activities, projecting outward the next 50 years of the Space Age in order to formulate a bold agenda for America's civilian space enterprise. "I believe a basic theme which comes out of our study, and is the heart of the matter," stated Dr. Thomas O. Paine, Chairman of the Commission, "is that the American space program will be what America decides to make it."

In issuing the report to both the President and the Congress, Dr. Paine explained that "the power of technology is so great, not only today, but as we see it advancing over the next 20 years, that it will be the decision of America, and the leadership that we provide to the rest of the world, that will determine what the world of the 21st century will be like. We're not predicting it, we are simply trying to say what we can make happen."

To develop a new long-range civilian space program, the Commission proposed a future-oriented civilian space agenda with three mutually-supportive thrusts:

- Advancing our understanding of our Solar System, and the Universe;
- Exploring, prospecting, and settling the Solar System; and
- Stimulating space enterprises for the direct benefit of the people on Earth.

These thrusts are judged by the Commission to be of comparable importance. To accomplish them economically, the Nation must make a long-range commitment to two additional thrusts:

- Advancing technology across a broad spectrum to assure timely availability of critical capabilities; and
- Creating and operating systems and institutions to provide low-cost access to the space frontier.

The Commission foresees new economical cargo and passenger transport vehicles to low Earth-orbit, augmented by the addition of a transfer vehicle for destinations beyond. These three systems would be available in conjunction with an "Earth Spaceport"—a transportation point in space for passengers and cargo—within 15 years. By the year 2000, robotic lunar surveys would have begun, with one objective to look for hidden caches of water, frozen at the lunar poles. Following these unpiloted investigations, lunar outposts to support astronauts would be established by about 2005, leading eventually to permanent bases on the Moon. The stretch to the planet Mars and its moons by astronauts would begin a decade later.

To accomplish these milestones, the Commission envisions an evolutionary network of spaceports near Earth, orbiting the Moon and Mars, and in a special location between the Earth and Moon, known as a Libration (L1) Point. Connecting the L1 Spaceport and the spaceport circling Mars would be "cycling spaceships," continually traveling between the orbits of Earth and Mars. The cycling spaceships, constructed similar to the spaceports, would allow routine access to the planet Mars. The Commission emphasizes that a U.S. return to the Moon and expeditions to Mars should not merely constitute brief expeditions, but set the stage for longer, systematic explorations—"eventually we will come to stay."

The proposed evolutionary steps as envisioned by the Commission can be realized within reasonable budget levels in an expanding economy. The Commissioners contend that their proposed 21st century civilian agenda is an investment which will remain below half of the highest percentages spent on the civilian space program during the peak Apollo years.

As stated in the Commission's report, "In view of the increasing significance of space and the critical economic importance of U.S. scientific and technological preeminence in the next century, we believe that these estimated levels of expenditure are reasonable in relation to the expected benefits to our Nation and the world."

Three specific changes to improve the management of America's civilian space program were recommended in the Commission report:

- Twenty-year civilian space program and 5-year budget planning to establish long-range goals and budgets for review and decision by the Administration and the Congress.
- Multi-year procurements to replace year-by-year funding, with firm decisions that eliminate annual changes which have proven very costly to NASA and its contractors.
- Two-year overall approval of civilian space budgets by the Office of Management and Budget and the appropriate Congressional committees to replace annual line-by-line auditing.

In addition, the Commission recommended reestablishment of a National Aeronautics and Space Council (as provided for by Congress in the NASA Act). This Council would be part of the White House organization and would develop the strategies and subsequent plans for new national space goals, ensuring prompt and effective cooperation and coordination among the Government agencies and departments responsible for the overall progress of America's space programs.

The phased growth of capabilities by the Commission would permit the opening of the space frontier for science, exploration and enterprise. The three hallmarks of this pioneering program are (1) economy through technological advances that reduce costs, (2) sustained investment to extend capabilities step-by-step, and (3) robotic processing of local resources to "live off the land," rather than supplying materials from Earth.

With regard to the prospects for international cooperation in our space future, the Commission strongly feels that collaborative efforts can help America fulfill its goals in space sooner and less expensively. The potential for U.S.-Soviet space ventures, the Commission believes, should be coordinated parallel missions, rather than joint ones. Within these guidelines, selective cooperation with the Soviet Union should be actively pursued. As for relationships with countries such as those in Western Europe, Japan, and Canada, the Commission recommended that continued cooperative space projects be pursued vigorously, with due regard for reciprocity and the protection of U.S. commercial interests.

The new space program the Commission proposes for 21st century America would return many benefits, serving as an exciting medium for the ingenuity of private companies, both established or entrepreneurial. The Commission anticipates tangible benefits from our future enterprise in space taking three forms:

- By "pulling-through" advances in science and technology of critical importance to the Nation's future economic strength and national security.
- By providing direct economic returns from new space-based enterprises that capitalize upon broad, low-cost access to space.
- By opening new worlds on the space frontier, with vast resources that can free humanity's aspirations from the limitations of our small planet of birth.

Calling the Solar System "our extended home," the

"The Report of the National Commission on Space charts a bold course for our nation, one designed to maintain United States leadership in space well into the 21st century and one that reflects the aspirations and vision of the American people."

—NASA Administrator James C. Fletcher.

Commission believes that ". . . space technology has freed humankind to move outward from the Earth as a species destined to expand to other worlds." As part of the rationale for exploring and settling the Solar System, the Commission asserts:

> "With America's pioneer heritage, technological preeminence, and economic strength, it is fitting that we should lead the people of this planet into space. Our leadership role should challenge the vision, talents, and energies of young and old alike, and inspire other nations to contribute their best talents to expand humanity's future."

The National Commission on Space realizes that the value of the report rests upon the extent to which its recommended space goals for 21st century America are adopted and acted upon. If the decision is made to proceed on the civilian space strategy as outlined by the Commission, the detailed review, planning, and budget preparation should be carried out by NASA in consultation with other agencies. The Comission has recommended that the President and the Congress direct the Administrator of NASA to review the Commission's findings and proposed space agenda, and by December 31, 1986, to recommend a long-range implementation plan, including a specific agenda for the next 5 years.

It is the view of the Commission that the immediate benefits from advances in science and technology and from new economic enterprises in space will be many and varied. In removing terrestrial limits to human aspirations, the execution of the Commission's proposed space agenda for 21st century America will prove of incalculable value to planet Earth and to the future of our species.

Lunar Soil Produces High Grade Concrete Material

Experimenting with ⅓ cup of NASA-supplied lunar soil samples, scientists created a concrete product stronger than concrete made with Earth materials.

Researchers at the Construction Technology Laboratory (CTL), Skokie, Ill., studied the strength and characteristics of the lunar sample to determine its suitability as an ingredient of construction grade concrete. Preliminary results revealed that concrete material made from lunar samples achieved a strength of 10,800 pounds per square inch (psi). This is about 5 percent stronger than equivalent, high-strength Earth concrete.

According to Dr. T. D. Linn, CTL principal research engineer, tests performed on a 1-inch cube and three slabs of lunar concrete provided evidence that lunar material will be useful for building concrete structures on the moon. "We are quite pleased that early results show the lunar concrete is of a higher quality than any developed using Earth materials. In previous tests, over a one-and-a-half-year period, using quartz sand, the highest rating attained was 10,260 psi," said Linn.

Current American Concrete Institute standards require a rating of 4,000 psi for slab and 5,000 psi for column, the most critical requirement in constructing buildings.

Linn said prior to the tests, the lunar soil was examined under a scanning electron microscope to determine its physical properties and appeared to make good concrete material. He added that lunar concrete contained no organic substances as is found in Earth concrete materials, which generally is considered an impurity.

The lunar soil sample was allocated to the Linn research team by NASA's Johnson Space Center, Houston, where the lunar rock collection is housed. The repository contains nearly 850 pounds of lunar material returned to Earth by Apollo astronauts from six manned missions to the moon.

According to respository curator Dr. Blanchard, "In supplying Dr. Linn and his associates with the lunar sample, we had hoped to study how we might use some of these materials to make a lunar base a viable opportunity. The results from Dr. Linn's investigations are very interesting. The fact that lunar cement behaves like high quality concrete made with Earth materials proves that it apparently works."

NASA planners anticipate a return to the moon after the turn of the century and the establishment of a permanent lunar base. Such a facility would require a variety of construction techniques designed for long-term life support in the harsh environment of the moon.

Emphasizing that the results are preliminary, Dr. Wendell Mendell, Johnson planetary scientist said, "These results, while they are preliminary in nature, are extremely interesting. We want to see what additional conclusions can be obtained from further examination of the data." Explaining the significance of the lunar soil tests, Dr. Mendell said, "Concrete is one of several materials being considered for building on the moon. If you can make a brick on the moon, you save a great deal of money. That's a tremendous incentive for learning to use lunar materials."

The proposal to study lunar soil as a possible source of building materials was made by CTL in 1984. The Lunar and Planetary Sample Team, a peer review panel which advises the lunar materials program at Johnson, approved the proposal to provide the lunar sample for study in the fall of 1985.

CTL is a non-profit research facility sponsored by the Portland Cement Association. Results from the lunar soil tests will be made available to the general public.

Dr. Franklin R. Chang-Diaz Selected to Receive the New Medal of Liberty

Dr. Franklin R. Chang-Diaz, the first NASA Hispanic-American astronaut to fly in space, was selected on March 1, 1986 as one of twelve outstanding naturalized American citizens to receive the Medal of Liberty, a new and prestigious national honor.

The Medal of Liberty is a new U.S. Government medal established this year to recognize living naturalized American citizens which have made significant contributions in their fields and to America's way of life. This medal is similar in prestige to the medal of Freedom.

The Medal of Liberty was presented to the twelve recipients by the President of the United States on the evening of July 3, 1986 aboard the aircraft carrier USS John F. Kennedy in New York harbor at the official unveiling of the Statue of Liberty and the relighting of her torch.

The selection of the twelve recipients was delegated to the Medal of Liberty Committee, chaired by Lee A. Iacocca. Researchers and historians from the Medal of Liberty Committee researched a large number of records to obtain names and qualifications of naturalized American citizens. The vast list of candidates thus obtained was whittled down to 200 considered to be the most significant. Biographies and accomplishments of these 200 were circulated and studied by the voting members of the Medal of Liberty Committee and the selection of the twelve recipients was accomplished by balloting of the members.

Dr. Chang-Diaz is the only recipient of Hispanic background in this illustrious group. He is also the only Federal government career employee and the youngest member in the group.

This selection is a great honor bestowed on Dr. Chang-Diaz, as well as a well deserved recognition of the contribution of NASA in general and the Astronaut corps in particular to American society.

The twelve illustrious recipients selected were:

Name	Field	Country of Origin
• Dr. Henry Kissinger	Former U.S. Secretary of State	Germany
• Mr. I. M. Pei	Architect	China
• Mr. Irving Berlin	Music Composer	Russia
• Dr. Hannah Holburn Gray	President - University of Chicago	Germany
• Dr. Kenneth Clark	Psychologist	Jamaica
• Mr. Elie Wiesel	Author - Chronicler of the Holocaust	Rumania
• Dr. Albert Sabin	M.D. - Developer of the Oral Polio Vaccine	Russia
• Mr. James B. Reston	Pulitzer Prize winning journalist, N.Y. Times columnist	Scotland
• Dr. An Wang	Corporate Executive	China
• Mr. Itzhak Perlman	Violinist	Israel
• Dr. Franklin R. Chang-Diaz	Astronaut - NASA	Costa Rica
• Mr. Bob Hope	Entertainer	England

Space Science to the Crime Lab

Criminals soon may be hurting from the heat of a space age spinoff proposed by a NASA scientist and a university law professor.

Dr. Jacob I. (Jack) Trombka of Goddard Space Flight Center, Greenbelt, Md. and professor Sam Dash of Georgetown University Law Center, Washington, D.C. have proposed the adaptation of state-of-the-art space exploration techniques and instrumentation for use in crime detection analysis, investigation and deterrence.

Their premise is that developments in these areas are out of touch with techniques, technology and hardware which are readily available.

As Dash and Trombka see it, many rugged, portable detectors developed for space applications could be used by mobile police crime lab technicians at the crime scene for chemical analysis of evidence to support their investigations.

The instrumentation which the two envision "transplanting" from a basically out-of-this-world habitat to Earth include neutron, gamma ray, x-ray, infrared, mass spectrometer and magnetometer devices.

Eventually, computer banks of investigative data would be compiled by specialty crime labs around the world and exchanged by law enforcement agencies through an international communications satellite network.

The two innovators cited various types of soils at the crime scene as an example of evidence which yields a detectable, tell-tale x-ray signature.

Armed with this signature, investigators then would query the appropriate lab for identifying data from the computer data bank of the specialty lab concerned via communications satellite.

With the computer-generated data in hand, investigators would have a powerful weapon for interrogation of the suspect, criminal charges and later conviction—not to speak of deterring similar crimes.

The law professor-scientist team recently outlined the space-age-to-the-crime lab proposal to the Secretary of Justice of Puerto Rico who currently has their proposal under consideration.

Commenting on the current state of criminal investigation, Dash said that, for example, "Handwriting analysis techniques date to 1609—we're talking more than 350 years ago—and they haven't changed since."

Further amplifying the need for state-of-the-art crime techniques, Trombka added that, "Most police today simply collect evidence at the crime scene but do not analyze it. The analysis must wait for later—often much later—with the use of heavy equipment at the crime lab. This presents the possibility of critically late identification and contaminated evidence." The Goddard scientist reasoned: "The more quickly we can identify and analyze—such as through mobile nuclear sensors and computer data banks—soil particles, bloodstains, hair, etc., the better the chance of apprehending criminals."

After identifying the problems of crime solving and deterrence through years of research, Dash and Trombka now have brought their proposal through the development stage and to the point of feasibility demonstration.

The Dash-Trombka proposal also can help reduce the chances of human error in the classification and analysis of evidence, improve the efficiency of the investigation, increase the credibility of the prosecution effort and, therefore, enhance the probability of justice being served.

From the Congressional Record

Senator Howell Heflin provided the following remarks on materials processing in space

Routine access to space creates great opportunity for the development and manufacture of materials of types and purities heretofore unavailable. Advanced high speed computers, lifesaving drugs, environment cleaning catalysts, new metals and glasses, and much more, are literally just beyond the horizon. This, largely, is made possible through the almost total escape from the Earth's gravitational forces into what is known as a microgravity environment. Here, warm air does not rise and liquids freeze uniformly instead of first from the surface. A constant and nearly perfect vacuum is readily available.

The potential of manufacturing materials in space is immense. Just as the rockets and spacecraft of the 1960's led to the multibillion-dollar telecommunications industry of today, manned space laboratories promise to engender an equally rewarding revolution in materials processing. The development of new materials in space will lead to an era of technological leadership for the Nation which opens this frontier. In fact, international competition has already begun. The United States, Japan, European nations and the Soviet Union have begun vigorous pursuit of these rewards. The challenge is there and we must meet it.

In pursuing this challenge there are several factors which must be examined including potential products, elements of the competition and the need.

Semiconductor materials have been at the very heart of the many products which have driven the current technological revolution. They are used for computing and data processing applications, for telecommunications, for sensor materials for military and medical usage, and for a wide variety of other electronic applications. In fact, millions of new careers have resulted from our ability to produce better and better semiconductor materials for communications and data processing components. And many now believe that we are approaching a second revolution in information processing through the utilization of light rather than electrons to communicate and store data.

The ability of semiconductors to process and store this information is dependent on the quality of the crystals from which the semiconductors are made. Large, uniform crystals free of contaminants provide the best materials for electronic and optical use.

Although materials scientists have succeeded in producing very high quality silicon for current applications, the gravitational effect known as thermal convection has limited their ability to produce more advanced materials capable of faster switching over a wider temperature range and which allow optical rather than electronic processing. The microgravity environment of space with its absence of thermal convection is expected to effectively eliminate previous uncontrolled variations in crystals made from such advanced semiconductor materials as gallium arsenide, indium antimony and mercury caldium telluride. In turn, these tremendous improvements in crystal quality should lead to revolutionary new applications in advanced computers, optical microcircuits and in sensors capable of responding to a very broad spectrum of light, ranging from microwaves and heat to x-rays and gamma rays.

Pharmaceuticals already are being developed commercially in space. In the last decade, biomedical researchers have uncovered a myriad of hormones, enzymes, and other substances which have had beneficial effects on people.

Because of sedimentation and buoyancy, both effects of Earth's gravity, many of these potentially lifesaving chemicals cannot be purified or produced in quantities allowing their routine use in the treatment of common illnesses. Other pharmaceuticals are totally impossible to formulate on Earth. However, all can become available in the microgravity of space laboratories.

Among the medical problems for which space-produced pharmaceuticals hold promise are cancer, diabetes, anemia, dwarfism, and hemophilia. Additionally, current research indicates the possibility of producing drugs which may reduce the need for blood transfusions during surgery.

Escape from Earth's gravity also eliminates the need to process materials within a container. This freedom allows production of glasses that cannot be duplicated on Earth where materials first freeze at the points of contact with the walls of the vessels in which they are contained. Also, most glasses are cooled from a very molten state which readily dissolves the materials from which glass crucibles are made. This introduces impurities which compromise the clarity and uniformity of the glass produced.

Containerless processing in microgravity laboratories will allow purer, more uniform glasses of new materials. This should lead to new applications for optical fiber materials which need fewer repeated stations.

Microgravity processing of metals will enable metallurgists to develop new alloys and establish reference standards against which to apply Earth-based research and development. This may lead to new forms of lightweight structures for aircraft and rockets to new high strength cast iron and steel, to new superconducting magnetic alloys and, indeed, to new understanding of fundamental metal properties.

Manufacturers of such traditional products as automobiles and farm implements already are conducting space-age research into new alloys.

Additional products for which new applications are being investigated include uniform calibration standards, molecular sieves and new nylon-like polymers. The first commercial cell of a space-based material was of monodisperse latex spheres which are used as a calibration standard for filters.

Molecular sieves produced under microgravity conditions promise to open new applications of gas separations, membranes for medical uses and purification of environmental pollutants and radioactive waste. Ultra high strength nylon fibers produced in microgravity are now being investigated by American industry.

Materials processing in space is being vigorously pursued by many nations. The nation which open this new frontier will be the leader of a new technological era. Those nations already active in this area are:

The United States performed a few simple experiments during the Skylab Program in 1973-74 and in the Apollo-Soyuz Test Program in 1975. This was followed by a long period of relative inactivity restricted to tests on a few very brief sounding rocket flights.

For the United States, the development of materials processing in space did not reach an appreciable level of activity until the introduction of the space shuttle in 1981. Since then, microgravity processing experiments have been carried aboard shuttle orbitors in almost every flight.

Several dozen American companies now have taken steps to secure a role in microgravity materials processing. Those which have invested their own resources to develop commercial opportunities in space range from some of the Nation's largest corporations to small entrepreneurs. They include industries involved in chemicals, metals, communications, aerospace and automotive products, farm machinery, and pharmaceuticals. Within the last year, a total of 34 companies and 12 universities have established 4 consortia to perform joint research in microgravity processing.

The Russians flew their first microgravity processing experiment in 1975 during the Apollo-Soyuz Test Program. They then embarked on a long-range experimental development program aboard the SALYUT manned space stations, and have had materials processing equipment in space continuously since 1978.

In contrast to the American program of sporadic, independent experiments, the Soviets have demonstrated a remarkable capacity for performing extended directed research. It has been estimated that the Russians, in total, have performed more than 1,600 materials processing experiments in the SALYUT space stations with international cosmonaut crews which have included East Germans, Poles, Hungarians, Cubans, Czechs, and Vietnamese.

Most of the Soviet Union's attention appears to have been directed at three semiconductor materials: gallium arsenide, indium antimonide and mercury cadmium telluride. Semiconductors using these materials are extremely valuable for military systems. They can be used for high speed computing and the development of radiation resistant signal processors and infrared sensors used for military applications. Any advantage that the Soviets gain in the ability to produce semiconductors of these high quality materials would readily translate to a strategic advantage in developing high speed, radiation resistant, high quality radars, sensors and missile guidance and navigation systems. The Soviets claim to have already manufactured and used for medical purposes infrared sensor devices which were made with mercury cadmium teluride produced aboard SALYUT.

In 1983 the Russians incorporated into the SALYUT system an unmanned re-entry module which can return up to 500 kilograms (1,100 pounds) of materials to Earth between crew visits to the station. Earlier this year, the Soviets stated that they will assemble and orbit large production complexes with semiconductor-materials production facilities, research laboratories and hothouses.

The Europeans and Japanese are expected to fly repeated missions aboard the space shuttle. The Europeans have already carried out a number of materials processing experiments in the space shuttle's space lab, operated by American and European scientists. West Germany flew a space lab mission in 1985 which focused on microgravity processing. The crew included two scientists from West Germany and one from Holland.

Recently, West German companies have established a new consortium, named IntoSpace, chartered to market its space processing opportunities to European industry, particularly those currently not involved in aerospace activities. The Japanese are scheduled to fly a Spacelab mission in 1988, focusing their attention on microgravity processing.

There seems little doubt as to the seriousness with which our allies—and others—intend to compete in this new commercial arena made possible by routine access to space.

Materials processing work will continue aboard the space shuttle once shuttle flights are restored. However, the shuttle will be flying only about once a month, and even then, it is in orbit for only about a week at a time. This is hardly long enough to perform the needed detailed development program. The key need is the permanently orbiting, manned space station now planned by NASA.

The space station will contain a laboratory for microgravity processing with the capability to perform the whole range of materials development necessary, from basic research through process development, technology advancement, commercial process prototyping, and commercial production of materials. Once in orbit in the 1990's, the space station will provide American science and industry the opportunity to gain and maintain a position of technological leadership in the applications of advanced materials into the 21st century. This leadership will be manifested in new forms of lifesaving drugs, in advanced computers, fluid processes, and in a new understanding of metals and glasses. It will lead to prosperity and to military strength and security.

Just as the development of orbital satellites has led to new jobs and economic growth in the telecommunications industry and as improved processing of silicon materials has led to great gains in the computer industry, advanced materials processing in space will bring about economic growth, security and improved medical care to our generation and those to follow.

Forecast For NASA's Quality and Productivity Enhancement Program

David R. Braunstein, who recently vacated his office as Director of NASA's Productivity Programs to assume a new managerial position at Douglas Aircraft in Long Beach, California, leaves behind a legacy of innovative productivity concepts and programs that will continue to have far-reaching impact on the American aerospace industry.

Mr. Braunstein had been a member of the NASA family since February 1980, at which time he held the position of Deputy Associate Administrator for Management in NASA's Space Shuttle Office. Two Exceptional Service Medals for management accomplishments were awarded to Mr. Braunstein during this period of service.

Prior to joining NASA, he was Director for Program Management with the Defense Advance Research Projects Agency (DARPA) from 1975 until 1980. While working for DARPA, he received the Secretary of Defense Meritorious Civilian Service Medal for management improvements. Mr. Braunstein had previously participated in the President's Executive Interchange Program.

Mr. Braunstain's ability to conceive ideas on a scale designed to extend the program's innovative concepts has resulted in a number of on-going executive achievements: the inception in 1984 of the NASA/Contractors Conference, now an annual affair; the 1984 Symposium on "Improving Quality and Productivity in Government and Industry" which ultimately led to the nine themes underpinning the productivity improvement and quality enhancement program; and the Government Quality Conference conducted for the first time in 1985.

In his remarks to NASA management staff at a recent Administrator's Reception held in his honor, Mr. Braunstein noted: "As I look forward to the future, I would like to make a prediction; a forecast based on the continued success of the Productivity Improvement and Quality Enhancement Program as an integral part of NASA's management philosophy.

I predict that in ten years, we will enjoy greater levels of trust between the contractor and government; the field installations and Headquarters; the executive and legislative bodies; and finally, between Union and Management.

We will come to expect, and receive, higher levels of quality from office, laboratory, and supplier resulting in a more superior product.

We will see the acceptance at NASA of a continuous improvement philosophy; the replacement of antiquated equipment with that of modern, and more comprehensive training programs. The Manager will act as both coach and team leader, encouraging employee contributions.

I predict that in fifteen years, organizations will routinely measure productivity and quality. Customer satisfaction will again emerge as a highly desired objective; quality of management and growth of productivity will work hand in hand with employee participation."

Mr. Braunstein will be remembered at NASA not only for his distinguished performance as the Agency's first Director of Productivity Programs, but also for his vision and dedication to performance improvement and product quality as goals of particular importance in NASA management thinking today. His efforts have led to NASA's being recognized as the leader in Government for productivity improvement and as one of the leading organizations in the Nation making progress to improve national productivity.

Newly Discovered Asteroids Could Provide for Future Space Mining

Studies of the makeup of two newly discovered asteroids that could possibly provide the basis for future mining in space were announced by astronomers and colleagues at NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif.

In work at several observatories, the astronomers have established that two near-Earth asteriods are probably composed chiefly of nickel-iron metal, much like some asteroids in the main asteroid belt and meteorites that impact Earth.

Astronomers previously suspected that such near-Earth asteroids were extinct comets. As such, they would have probably originated in the far outer solar system where comets are believed to have formed.

Nickel-iron asteroids, on the other hand, would have probably formed in the inner solar system. Most would have originated along with objects in the main asteroid belt orbiting the sun between Mars and Jupiter. Metallic near-Earth asteroids, however, may have begun as part of the cloud of material that condensed and became Earth.

One of the two asteroids studied, designated 1986 EB when it was discovered earlier this year, is known as an Aten-class asteroid — one whose orbit is inside Earth's. The other, designated 1986 DA, belongs to the Amor class — asteroids whose orbits are close to Earth's, but which are beyond Earth's orbit and do not cross it. Both are about one mile in diameter.

The observations were made by planetary astronomers Dr. Edward Tedesco of JPL and Dr. Jonathan gradie of the University of Hawaii.

Using the 120-inch NASA Infrared Telescope at Hawaii's Mauna Kea Observatory, they found that the two asteroids have spectral qualities and albedo that put them in the same class as metallic asteriods of the main asteroid belt (albedo refers to an object's reflectivity). Astronomers study the light, or spectra, of an object to determine its chemical composition.

Tedesco made later observations at Arizona's Kitt Peak National Observatory with Dr. Robert Nelson of JPL and at Mauna Kea with Dr. Marc Buie of the University of Hawaii.

The astronomers noted that metallic asteriods near-Earth might provide suitable sites for future mining operations in space, as has been proposed to provide raw materials for possible interplanetary expeditions in the 21st century.

NASA Space Technology Enhances Disease Detection

Scientists and medical researchers at NASA's National Space Technology Laboratories (NSTL), Bay St. Louis, Miss., are using satellite remote sensing technology to assist in developing a new method of analyzing the human body, including disease detection and tumor and blood clot analysis.

The use of advanced remote sensing technology as a medical research tool in a new body scanning technique, known as nuclear magnetic resonance (NMR), began in April 1985. The project is a 3-year collaborative effort between Washington University's Mallinckrodt Institute of Radiology, St. Louis, Mo., NASA Kennedy Space Center, Fla., and NSTL.

According to Doug Rickman, one of two NSTL Earth Resources Laboratory scientists working on the project, NMR hardware has been in existence since the 1940s. However, it has been used recently as a diagnostic tool by physicians. NMR scanning is regarded as an improvement over CAT SCAN, an X-ray technique sensitive to bone density. NMR, however, is sensitive to soft tissue and allows doctors to make more accurate diagnosis of diseases because of NMR's capability to show images of soft tissues in the body.

At NSTL, Rickman and fellow scientist Jim Anderson have applied the NASA-developed software, used in processing satellite imagery, to enhance the NMR images. This process is expected to improve the accuracy of disease detection. By incorporating the software into the system, NMR scans provide better information on a tumor's size and location as well as its biological attitude. Doctors can more easily get an accurate status of a tumor's mass without having to enter the body surgically.

The cooperative effort between NASA and Washington University began in 1980 because of the similarity of multispectral medical data and multispectral satellite data. However, NMR-produced data are black-and-white images and, therefore, are difficult to interpret. Currently, the images resemble X-rays and are treated as such by doctors making diagnosis.

NASA scientists hope to make medical diagnosis simpler by assigning color values to enhance the computer images. Kennedy Space Center, in a joint effort with the University of Florida, made the initial color composites. The work at NSTL seeks to improve the enhanced color images by training the NMR scanner to be consistent in identifying materials in the body, as a means of insuring the unit's maximum use potential.

Rickman said: "The color images ease the physician's task, which should make it more accurate in the long run. It is quite difficult to interpret the black-and-white images but simple to interpret the color ones."

Dr. Michael Vannier, radiologist and principal project investigator, believes the union with NASA is vital to maximize the potential of NMR scanning. "No one in medicine really has the kind of experience with classifying or analyzing these types of images this way. That's why we're using NASA expertise to help us," Vannier said.

According to Vannier, the NMR has been used on a number of organ systems in the brain. Recently, the National Cancer Institute, Bethesda, Md., expressed interest in NMR because of its potential use in breast diagnostic techniques. Doctors John Gohagen and Ed Spitznagel, both of Washington University, were selected by the Cancer Institute to work along with Vannier, as representatives of the institute-sponsored Breast Imaging Project.

Gohagen emphasizing the importance of close affiliation with pathologists while working with actual cases to determine the accuracy of image classification. He said, "Our goal is to get the kind of discrimination necessary to distinguish anamolous conditions. For example, blood clots will appear distinctly different from benign tumors and a marked difference will be evident between benign and malignant tumors."

Explaining the project objective, NSTL scientist Anderson stated, "The NMR images in their present black-and-white format are useful to the physician, but we're talking about a quantum leap forward using NASA image processing. Our purpose is to produce a product which can be used by the physician to enhance or finalize the diagnosis."

"What we expect this type of technology to do," Vannier concluded," is to help us answer a lot of very specific questions that influence the management of patients. I think it will have a significant effect on what we do in the future."

New Asteroid/Comet Nuclei Hazard Studies Announced

New studies of the hazards posed by asteroids or comet nuclei colliding with the Earth, based on analyzing old craters on the Earth and Moon, have been announced by astronomers performing research for NASA.

In two papers delivered May 20 at the annual meeting of the American Geophysical Union in Baltimore, Md., the scientists estimate that a collision by a large asteroid could be catastrophic. The chances of such an event occurring in the next century, however, are extremely remote.

A scenario of greater concern, they said, would be a far more probable encounter with a smaller object, a large meteoroid. Objects of that size explode when they enter the atmosphere. Such an explosion could be mistaken by some of the world's less technically advanced nations for a nuclear attack, prompting undesirable political consequences.

The papers were authored by Dr. Alan Harris, a Jet Propulsion Laboratory planetary scientist, and Dr. Eugene Shoemaker, a U.S. Geological Survey scientist who serves in NASA's Planet-Crossing Asteroid Program.

In one paper, Harris and Shoemaker estimated that the odds of an asteroid or comet nucleus one-third mile in diameter or larger hitting the Earth in the next 100 years are only 1 in 1,000.

In the other paper, Shoemaker calculated the effects of collisions by asteroids of various sizes. An asteroid one-third mile in diameter would release energy equivalent to 10,000 megatons of TNT and leave a crater six miles in diameter.

Despite the low probability of such a collision, the astronomers said, systematic sky searches for near-Earth asteroids, combined with advance emergency planning, are prudent steps to reduce further the possibility of an unexpected disaster.

"Increase in the discovery rate of these objects from an average of 3 to about 30 per year can be achieved with a moderate level of research support," Harris said.

Over 30 to 50 years, he said, most Earth-crossing asteroids down to about one-third diameter can probably be discovered.

If a collision was forseen, it would be possible to predict the time and impact location with high accuracy allowing the threatened area to be evacuated.

Some day, Harris noted, it may be possible to avoid a collision altogether, either by modifying the asteroid's orbit or breaking it up into a relatively harmless swarm of smaller pieces. The energies required for either strategy would require thermonuclear energy.

Comets are more difficult to predict than asteroids. Asteroids usually occupy orbits similar to the Earth's, making the object visible longer in advance if it were to approach the Earth. Comet orbits, on the other hand, are highly elliptical, bringing them in from the outer solar system with less advance warning.

Nevertheless, tracking of the comet and evacuation of the impact area would be practical means of avoiding a major disaster.

The scientists emphasized that such large events are extremely improbable, placing more concern on the effects of a meteoroid up to about 330 feet in diameter entering Earth's atmosphere. Events of that size are estimated to occur once every few decades. One such event was probably responsible for a nuclear-device-like explosion over Tunguska, Siberia in 1908.

The world's most technically advanced nations would be able to identify such a meteoric fireball for what it is. Nations lacking that technical ability, however, could mistake the fireball for the air burst of a nuclear weapon and attempt retaliation against hostile neighbors.

That issue, they recommend, should be addressed at the international level.

Harris and Shoemaker arrived at their statistical probability by analyzing and dating craters around the Earth and on its Moon.

Did You Know?

NASA, in association with The Atlanta University Center, Inc., hosted the first annual NASA-HBCU (Historically Black Colleges and Universities) FORUM, April 20-22, 1986 at Atlanta, Georgia.

The Forum, provided HBCU's and NASA an opportunity to present accomplishments in research and student development.

More than 250 students, professors and administrators from HBCU's attended. Featured guests include Dr. Frank McDonald, NASA's Chief Scientist; US Congressman Mervyn Dymally; and Isaac Gillam, Assistant Administrator-Commercial Programs, Dr. Harriett Jenkins, Assistant Administrator, Equal Opportunity Programs, NASA; Charles Bolden, Astronaut/Pilot, NASA and top scholars from America's Black colleges and universities.

Students presented more than 50 papers relating to various aspects of NASA and space exploration.

Through the Forum, attendees received a comprehensive view of the present and future NASA-HBCU relationships and the participation of industry and other governmental agencies.

The Forum was conducted under the direction of the office of NASA Chief Scientist in cooperation with The Atlanta University Center's Dolphus E. Milligan Science Research Institute.

NASA will sponsor a major conference on the planet Mars, to coincide with the tenth anniversary of the Viking missions that explored Mars in 1976. The conference will be held July 21-23, 1986, at the National Academy of Sciences in Washington, D.C.

The conference will be sponsored by the Solar System Exploration Division of NASA's Office of Space Science and Applications.

The purpose of the conference is to take a comprehensive look at present knowledge and understanding of Mars; present and future exploration of the planet; and issues and options for further manned exploration.

Subjects to be discussed will include the geology, volcansim, channels, moons, meteorology, polar regions and biology of Mars. Exploration programs considered will include observer missions, aeronomy, seismic network, sample return and the 1988 Russian Mars program. Discussions of human exploration will include transportation systems, key technologies and life support.

Anyone interested in the history, science and exploration of Mars is invited to attend the conference. Attendance will be first-come, first-served, and limited to 600 people.

For further information, write to The Mars Conference, Mrs. Lu Agee, P.O. Box 416, Hampton, Va. 23669. Telephone (804) 865-8400.

Successful ground testing of a unique auxiliary propulsion system for Space Station marked a milestone in NASA's program to demonstrate that such thrusters can operate for long periods with no hardware degradation.

A key element in this new technology development is the viability of using the electrolysis of water onboard Space Station as the propellant source for the thrusters. In this process, water is broken down into hydrogen and oxygen and these gases are then burned as the fuel.

The tests were conducted for NASA's Lewis Research Center, Cleveland, by Aerospace Textron, Buffalo, N.Y., and Aerojet TechSystem Corp, Sacramento, Calif. Under parallel contracts awarded in 1985, the two companies are charged with design, fabrication and test of small (25-to-50-pound) thrusters based on technology developed by NASA's Office of Aeronautics and Space Technology.

The thrusters ran for as long as 22,000 seconds. With a target of some 10 years of Space Station life, a run of 40,000 to 60,000 seconds is the goal. Banks of these thrusters will be used onboard Space Station to maintain proper orbit and attitude.

NASA will bring an all-new exhibit featuring the National Aerospace Plane to this summer's EAA OSHKOSH '86.

The air-breathing space plane, referred to by President Ronald Reagan as the "Orient Express" during his State of the Union address, will be capable of flying at speeds up to Mach 25 in the upper atmosphere from the West Coast of the United States to Tokyo in just two hours, for example. Comparable subsonic flights require more than 10 hours.

The 6,000 square-foot exhibit facility will be filled with examples of NASA research tools and exploratory techniques necessary for 21st century aircraft. Increasing computer capabilities are among the many areas currently being studied by NASA researchers. For example, the agency's Ames Research Center in Mountain View, CA, has a new "supercomputer and simulation complex" that will soon be capable of performing 1 billion computations per second. Complex measurements of aerodynamic flow fields that once took days or weeks to perform will now take only minutes. The aerospace industry and universities will soon be able to make use of this resource.

Another highlight of NASA's EAA OSHKOSH '86 presence will be four of the agency's test pilots and their aircraft. Research pilots are an important part of many flight research programs conducted at NASA centers around the country. Flying an interesting mix of missions in a variety of aircraft, some of these pilots might well be the first ones to take America's aerospace plane into orbit.

Other displays that will be featured at EAA OSHKOSH '86 are NASA's first exhibit of aeronautical art that includes works from the nation's foremost artists; a close look at rotorcraft research and potential applications; and examples of NASA's aeronautical research and development efforts that will be located throughout the new display area.

The three NASA aeronautics field centers supporting this year's EAA OSHKOSH exhibit are Langley Research Center in Hampton, VA; Lewis Research Center in Cleveland, OH; and Ames Research Center in Mountain View, CA, which includes the Dryden Flight Research Facility at Edwards Air Force Base.

For the second consecutive year, the Goddard Space Flight Center in Greenbelt, MD, will provide its SARSAT van, a mobile exhibit that presents an overview of the Search and Rescue Satellite system.

During testimony to the House Committee on Science and Technology, James C. Fletcher, NASA Administrator, and Rear Admiral Richard H. Truly, NASA Associate Administrator for Space Flight, announced that astronaut Robert L. Crippen (Capt., USN) has been assigned to head a small group which will examine the overall Space Shuttle program management. Where changes to existing organization or lines of authority are deemed appropriate, the group will recommend solutions for approval.

This review was part of the recommendations of the Presidential Commission on the Space Shuttle Challenger Accident, headed by William P. Rogers, to flight status, issued March 24. In this plan Truly stated, "The National Space Transportation System (NSTS)) program management philosophy, structure, reporting channels and decision-making process will be thoroughly reviewed and those changes implemented which are required to assure confidence and safety in the overall program, including the commit to launch process."

Crippen's group will review the findings and conclusions of the Rogers Commission leading up to the Commission's recommendations on Shuttle management structure, the use of astronauts in NASA management positions, the creation of a Shuttle safety panel and improved communications within the Shuttle program. Part of the review process will entail discussions with former NASA managers (e.g., previous associate administrators) and others inside and outside NASA to solicit their opinions and advice on the subjects of the study. Other members of the group will be announced later.

On announcing the assignment, Truly said, "Captain Crippen, a veteran of four Shuttle flights, is extremely well qualified to lead this project by virtue of his extensive experience in several NASA programs including the Shuttle.

NASA and Boeing Aerospace Company, Seattle, WA., have entered into an agreement to fly a series of materials processing experiments on the Space Shuttle.

Objective of the experiments is to prove that crystals of a size and quality impossible to create on Earth can be produced in space. These crystals are expected to be of a type valuable in the commercial production of semiconductor and electro-optic devices.

The experiments involve the manned operation of a chemical vapor transport crystal growth furnace which will be installed in the galley area of the Shuttle orbiter mid-deck compartment.

Boeing expects to fly a total of three separate furnaces on each of the three flights. The Universtity of Alabama, Huntsville, with which Boeing is affiliated under the NASA program of Centers for the Development of Space, also will perform experiments in the Boeing furnaces during the flight program. There is an option for two additional flights for prototype production experiments if the program yields promising results.

Under the agreement, Boeing will fund the experiments, provide the crystal growth furnace and other needed equipment. Boeing also will process some NASA samples in its furnace on each flight. NASA agrees to integrate the experimental packages into the Space Shuttle, provide available off-the-shelf support equipment where applicable and provide room and crew support on Shuttle flights.

NASA's involvement in this agreement and others underscores the agency's commitment to the development of commercial endeavors in space, particularly in relation to the Space Station.

The American Historical Association named the first recipient of an annual aerospace history fellowship jointly sponsored by the Association and NASA. He is Dr. Norriss Hetherington, Research Associate at the University of California, Berkeley. While the history of astronomy has been Dr. Hetherington's principal area of research, he will devote his fellowship year to the study of early aeronautical research.

The American Historical Association annual fellowship in Aerospace history is designed to attract both junior and senior scholars to the study of modern aerospace history from a variety of perspectives.

NASA Ames-Dryden Flight Research Facility engineer Marta R. Bohn-Meyer became one of only a handful of American women who have flown at supersonic speeds above 50,000 feet.

Bohn-Meyer flew as flight test engineer in the rear seat of a F-104 aircraft that Ames-Dryden uses to fly experiments requiring very low gravity conditions, similar to those found during Space Shuttle flights. One experiment flown previously was to observe the low gravity effect on solidifying molten cast iron.

Flights above 50,000 feet require use of a pressure suit. Bohn-Meyer's preparations included altitude chamber and survival training while wearing the suit.

"The whole experience was really neat, so different and unique, something I never expected to experience in my life," says Bohn-Meyer. "People really put a lot of effort into my training and a lot of faith in me. I hope to repay them by doing the best job I can."

NASA announced plans to procure a Tracking and Data Relay Satellite (TDRS) to replace the one lost in the Challenger accident.

Plans call for a replacement spacecraft and follow-on satellites to keep the TDRS system operational through the end of the century. NASA will procure the replacement spacecraft with parts for a second spacecraft from

TRW, Electronics and Defense Sector, Redondo Beach, Calif., on a sole source basis. Value of the contract will be negotiated with TRW. Delivery of the replacement spacecraft is scheduled for September 1991.

A TDRS follow-on study will be initiated in late 1986 leading to a decision to competitively procure advanced, follow-on spacecraft with deliveries planned to begin in 1996.

The currently operational TDRS 1 is in geosynchronous orbit over the Atlantic Ocean just east of Brazil (41 degrees west longitude).

Contractor News

NASA Lewis Research Center, Cleveland, selected **G. R. Osterland Company,** Cleveland, for final negotiations leading to award of a cost-plus-award-fee, 5-year contract valued at approximately $22 million for routine construction, modification and maintenance services. All work will be performed on-site.

The contractor will be responsible for interior and exterior painting, insulation and asbestos removal, roof repair, road and parking lot repair, demolition work, electrical heating and air conditioning, piping and other general repair and rehab of Lewis facilities.

NASA's Johnson Space Center, Houston, selected **Stellacom, Inc.** for negotiations of a cost-plus-award-fee contract for Center television support services.

The contract, which started June 1, 1986, will be valued at about $4.3 million. JSC has the option to extend the contract for one-year periods.

Stellacon will operate the JSC closed-circuit television system and videotape library, process Shuttle Orbiter downlink television, provide technical support for press conferences and teleconferencing, produce training tapes, supply all television engineering, and maintain/repair all television equipment.

Stellacom is a joint venture of Avid Productions, Inc. of Houston and Third Coast Video, Inc. of Austin, Texas.

NASA's Ames Research Center, Mountain View, Calif., entered into a Small Business Innovation Research contract with **ACA Industries,** Palos Verdes, Calif., to build the advanced concept joined wing. Initial flight tests are planned by ACA Industries for early 1988 at Mojave, Calif. The estimated value of this 2-year contract is approximately $500,000.

The joined wing is an advanced aircraft design incorporating a swept-back main wing that is joined, close to its wing tips, to a swept-forward rear wing. Stronger aircraft structures and increased fuel efficiency are the primary benefits anticipated.

The purpose of the program, declared NASA's Dr. David J. Peake, Chief, Advanced Aerodynamic Concepts Branch at Ames and Robert Baron, Project Office, Ames-Dryden Flight Research Facility, Edwards, Calif., is to build, ground certify and flight test a joined-wing research/flight demonstrator aircraft.

NASA selected **Bamsi, Inc.,** Titusville, Fla., for final negotiations leading to the award of a 5-year support services contract, effective July 1, 1986. As a competitively negotiated procurement, the first 3 years of the contract has a proposed value of $9 million.

Bamsi, Inc. will provide on-site maintenance support services and incidental construction at Ames Research Center, Mountain View, Calif. This contract will provide personnel, material, equipment and other resources necessary to perform maintenance services in the following general areas: electrical services, mechanical services, plumbing, pipe-fitting and utility services, building trades service, and heating, air conditioning, environmental and refrigeration systems services.

Micro Craft Inc., Tullahoma, Tenn. and Hampton, Va., and **DEI-East Inc.,** Newport News, Va., were selected for negotiation of individual contracts to design and fabricate precision aerospace models for wind tunnel tests at NASA Langely Research Center, Hampton, Va.

The models delivered under the contracts will support the overall NASA aeronautics research program and may include advanced aerospace, DOD, commercial and general aviation configurations.

Two cost-plus-award-fee contracts will cover a period of 3 years, with 2-year options. Total value of the combined contracts is approximately $20 million.

Wind tunnel models must accurately represent the aerodynamic shapes, aeroelastic properties or dynamic properties as required for particular tests.

The two companies will build models of various scale sizes, which may have complex contoured shapes and highly cambered and twisted wings with controlled shapes and finishes. Exacting dimensional tolerances and surface finishes may be required for wind tunnel models. Some models may be tested at temperatures as low as minus 300 degrees F. Others may be tested at temperatures as high as 2,000 degrees F.

The companies will build the models at their facilities.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Heart Monitor

MONITOR ONE, a portable, computerized cardiac system offers physicians a new approach for monitoring ambulatory patients with coronary artery disease. The cardiac monitor, alerts the patient to impending high-risk cardiac events by continuously evaluating the electrocardiographic signals generated by the heart. MONITOR ONE, which incorporates NASA technology, is the product of three years of research and development by Q-Med Inc., Clark New Jersey.

Approximately six inches long and three inches wide, MONITOR ONE weighs 14 ounces; it may be attached to a patient's garment or carried in a pocket, and it does not interfere with daily routine.

MONITOR ONE may be worn for days, weeks, months or years. It evaluates every heartbeat and makes immediate decisions as to the normalcy or abnormalcy of the beats. Each abnormal event defined by the computer is stored for later review by the physician, who may program various thresholds for different patients. MONITOR ONE not only enables a physician to track a patient's progress over a long period, but also allows him to evaluate the efficacy of drug treatment and to adjust dosages accordingly.

MONITOR ONE was developed by three cofounders of Q-Med Inc. They recognized early in the R&D program that the key to successful development of an ambulatory mode system was the electrode—it had to last for long periods, provide high fidelity and not require constant skin abrasion in order to function properly. NASA's Johnson Space Center Houston, Tx., had successfully developed advanced electrodes for monitoring the heart action of Space Shuttle astronauts. The Q-Med team learned of the JSC technology and tested samples of the NASA electrodes; they proved to be ideal for MONITOR ONE. Q-Med was granted an exclusive license to manufacture and market the electrodes and in August 1984 the company was advised by the Food and Drug Administration that it could begin marketing the MONITOR ONE system. Initial deliveries of MONITOR ONE, manufactured for Q-Med by Rodale Electronics, Garden City, New York, were made last January.

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* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

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NASA Activities

National
Aeronautics and
Space
Administration

August-September 1986
Vol. 17, No. 8 & 9

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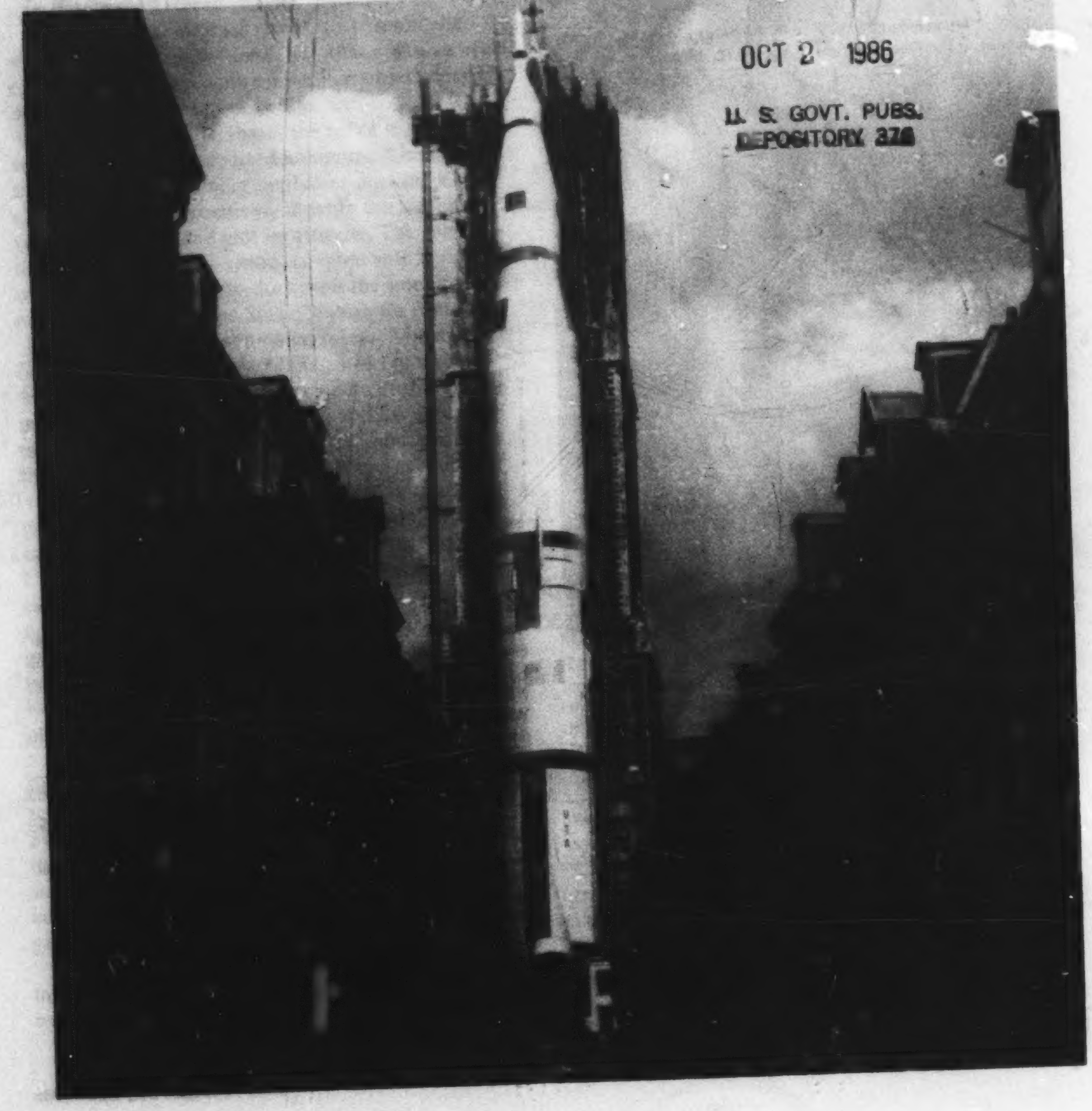

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About the Cover

A full scale model of the Saturn V rocket was placed in the center of the city of Utrecht (The Netherlands). This 110-meter-high two dimensional replica was erected against the 600-year-old Domtower. Coincidently, this tower has the same height as a Saturn V rocket. The idea for this remarkable feat came from Chriet Titulaer, a Dutch writer about space and science.

Utrecht housed the exhibition Space '86 with among many other unique items, full scale models of the Lunar Module, the Lunar Rover, an Apollo capsule (original), an Apollo parachute (original), an Intelsat VI, Giotto, Ulysses, Spacelab (original training-model), ECS, OTS, IRAS and ANS.

Space '86 also comprised a Space Art exhibition with the participation of the major Space artists from the USA and the USSR.

Space '86 concluded June 29, with the Saturn V model remaining at the Domtower until August 31, 1986.

Contents

Teaching Machines To See 3
Remotely-Controlled Camera Records Bald Eagle Family Life 4
NASA Features Aero-Space Plane, Pilots at EAA Convention 6
NASA Supercomputer System To Become Available Nationally 7
Trials Don't Erase NASA's Proud Record 8
From The Congressional Record 9
Scientist Revolutionizes Making Of Sunglasses Lenses 12
Did You Know? 12
Contractor News 19
Another Dividend From Air and Space 20

NASA Activities is published monthly by the National Aeronautics and Space Administration for the information of the agency's employees. Contributions and recommendations are solicited from Headquarters and field centers and should be addressed to Editor, NASA Activities, News and Information Branch, Code LFD-2, Washington, D.C. 20546. Material submitted for publication cannot be returned.

Distributed free of charge only to current agency employees. Available by subscription from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Check or money order should be made payable to Superintendent of Documents, GPO. Subscription rates are $23.00/year, domestic; $28.75/year, foreign.

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Teaching Machines To See

It is always quiet on the high frontier, 23,300 miles above the Earth, but in one particular spot in the valuable orbit where communications satellites do their work, a certain stillness signals a malfunction. A $60 million Comsat belonging to a U.S. consortium is dead in space. But help is on the way.

A robot vehicle has been sent up from the U.S. Space Station in low Earth orbit. As the robot moves in on the disabled satellite, it scans the spacecraft, comparing real time holographic imagery with its own database of stored images.

The robot has, in other words, just "seen" the satellite — in much the same way that a human eye can perceive and recognize a familiar object despite differences in orientation or distance.

From its internal database, the robot is able to compare the newly acquired holographic images of the satellite with memory, and after drawing a correlation, is able to positively identify the satellite, verify its position and plot its attitude. The robot then uses its synthetic vision, coupled with a variety of automatic controls, to dock with the satellite and maneuver it back to the Space Station for repairs.

As a result of synthetic vision research being done by Dr. Richard D. Juday, Manager of Optical Information Processing, other members of the Tracking Techniques Branch, Tracking and Communications Division, and other groups around the Center, this hypothetical scenario may be a future reality.

Juday is working on development of optical tracking techniques using Fourier optics, spatial light modulators, optical filters and optical correlators. Ultimately, these devices and techniques will allow a camera system, using the interactions of coherent light beams (and the properties of those beams), modulated by the camera images, to act as a virtual mimic of the human eye and brain. The system would be able to search for and identify various objects in space.

Before that is possible, however, a machine must first be able to cope with variables in sighting and recognition, such as distance and orientation Jeff Swartz, Tracking Techniques Branch, is working on the design for a programmable retina that might help solve that problem. The retina would be used to adapt images so they could be easily identified regardless of their rotation or magnification.

"We are able to recognize an object even as distance and orientation change. We're looking at biological models for the programmable retina with respect to pattern recognition," Juday said. He is working with Dr. Marianne Rudisill, Crew Station Design Section, Man-Systems Division, on the flow of information through a biological system and how that can be adapted to synthetic vision.

Drs. Richard Juday and David Loshin examine a computer-controlled 2-axis positioner, part of the synthetic vision system they and others are working on. The positioner, designed and built by cooperative education students Tim Fisher and Brian Diauto, would aid the system in recognizing objects.

George Chaikin of Cooper Union in New York is also involved in applying the biological models to synthetic vision research. Juday, Rudisill and Chaikin are among a group of JSC employees, contractors and summer research faculty who are conducting a weekly colloquium on topics relating to synthetic vision and how it relates to NASA's long term requirements.

"I think we can come up with an optimum engineering system. The idea is to simulate, with elec-

READEX best copy available

tronics hardware, and with digital processing and optical coherent light processing, some of the aspects of biological vision systems," Juday said.

Funding for the research comes from the Technology Utilization Office and from the U.S. Army. Both organizations are interested in possible technology spinoff applications.

During the summer, Dr. David Loshin, an optometrist from the University of Houston, is working with Juday to see if some of NASA's research can assist the elderly with various vision problems. "NASA is allied with other groups, such as the National Institute for Aging and the National Institutes for Health to see what kind of technology can be used to help the general populace," Juday said.

One such application is age-related maculopathy, a vision deficiency resulting in a blind spot in the central part of a person's vision. Since there is a peripheral field of vision around the blind spot, researchers believe a programmable retina could help reproduce a complete picture in the surrounding area of vision.

As now envisioned, the equipment would consist of a small TV camera and a small display in front of the eye. Juday said the display would resemble a picture printed on a rubber sheet with a hole in the middle, then stretched out so that all of the image could be viewed in the peripheral area. "With the stretched out image, it would not look normal, but a person may be able to use it without being unduly disturbed by it. And it would give them more visual acuity. The images would look funny, but a person's visual processes are vary adaptive in being able to accommodate to strange circumstances," Juday said.

Military applications for optical tracking have already been tested, Juday said. "A number of people are working on that with varied success. There was a robot at Carnegie-Mellon University that found a couple of parallel lines to drive between — the only problem was that the lines were the left and right sides of a tree. Humans are certainly more adaptable than machines, but we would like to put artificial intelligence to work."

Juday has worked at JSC since his graduation from Rice University in 1966. While working here he has earned a masters degree from the University of Houston and in May was awarded a Ph.D. from Texas A&M University.

Juday worked in the Earth observations and remote sensing disciplines before going to work in the Tracking and Communications Division, and said his earlier work in image registration has carried over naturally into synthetic vision research.

Laboratory equipment for the research varies from the highly sophisticated to the highly innovative. Physicist Dr. Stan Monroe, for example, is using a miniature, off-the-shelf Radio Shack television, coupled with lasers and optical filters, to process images. At the same time, Texas Instruments is developing a spatial light modulator and will be delivering an optical correlator later this summer.

Another piece of equipment for the synthetic vision system was entirely designed and built by cooperative education students Tim Fisher and Brian Diauto. It is a two-axis positioner that would in some ways perform the same function as a human being's hand does in the process of pattern recognition. "When somebody hands you an object and says, 'Okay, what is it?' you naturally turn it over in your hands until you recognize it," Juday said. The positioner would rotate an image of a certain object until it matched up with a cataloged image in the computer memory.

The variety of individuals and organizations working on synthetic vision research is far reaching, and the researchers say they believe the development of new technology and equipment is advancing rapidly. With the addition of such equipment as optical correlators and spatial light modulators, they are looking forward to even more research capability in the future.

Remotely-Controlled Camera Records Bald Eagle Family Life

Whether gliding gracefully on broad-stretched wings or making power dives on unsuspecting prey, there are few sights in nature more dramatic than the American bald eagle at home in the wild. These are spectacles which few Americans are privileged to watch.

Only naturalists, wildlife managers and a few enterprising photographers have been able to witness eagle family life on the nest, a situation altered by photographs taken by a remotely-operated camera overlooking a Kennedy Space Center eagle nest.

The number of active southern bald eagle nests on the sprawling NASA Spaceport, originally acquired in the early 1960s for the Project Apollo voyages to the Moon, ranges from five to seven. The most visible nest is located in a tall pine tree to the west of the Kennedy Parkway between the Industrial Area and Launch Complex 39.

The adult birds have apparently adapted to the fire and thunder of rocket launches as well as the heavy automobile traffic on the center's major north-south highway. Nor do they seem to be disturbed by a large camera box placed on a pine tree branch overlooking their nest from a distance of less than five feet.

The remote camera installation has been used to some extent since the early 1980s, but the photographic results from the breeding season just ended has produced the most spectacular coverage yet.

The 217 color photographs cover the period from Oct. 21, 1985 through March 18 of this year. They yield fascinating insights into the eagles' nesting behavior and the growth of a young eaglet from a down-covered chick to a robust fledgling able to make it on its own.

"This was our best season," commented Klaus Wilckens, the TGS Technology Inc. photographer who found time between 9 and 10:30 a.m. each working day to observe the nest and click the shutter if there was any visible action. TGS is the photographic contractor for the NASA Kennedy Space Center and the U.S. Air Force Eastern Space and Missile Center.

TGS technician Roland "Red" Williams, adapted a camera housing — normally used on Complex 39 launch structures — for service at the eagle nest located about 60 feet above the ground in the crotch of the tall pine tree.

The camera was a motor-driven F2 Nikon 35 millimeter with a 35 mm lens and a 250-exposure back. A six-volt battery in a weatherproof camera box disguised with camouflage paint was used to trip the shutter in single frames. Sound was deadened by foam insulation and moisture-absorbing crystals were placed in the box to control humidity. The box was sealed around the edges with silicone. The film was Vericolor Type S with a speed of ASA 100.

The control cable was housed in a protective conduit which extended down to the base of the tree and then underground and across a nearby drainage ditch. It then passed beneath Kennedy Parkway and emerged through a drainage grate in the median strip. It was from this vantage point that Wilckens conducted his daily vigil with powerful binoculars and tripped the shutter.

Those areas of the Spaceport not actively used for space operations are maintained for NASA by the U.S. Fish and Wildlife Service as the Merritt Island National Wildlife Refuge and the photographic effort was coordinated with wildlife officials on both the local and national level.

The camera box was erected in the tree on Aug. 12, 1985. It overlooked a nest about seven feet in diameter and approximately eight feet deep. It is generally flat on top with only a shallow depression in the center to shelter the egg and then the chick. The nests are used over and over again and there are records showing occupancy of this particular nest as early as 1964.

Wilckens' log records the first appearance of the adult birds at the nest on Oct. 21. Their first order of business was the repair of the nest and the erection of a raised barrier of twigs and small branches around the perimeter of the nest. A number of the photographs show the adult bird making nest repairs.

The single egg is first visible in a photograph taken on Nov. 15 and the down-covered hatchling made its debut in a shot taken on Jan. 2. The chick was only three to four inches long when hatched and its growth was rapid; by the time the final picture was taken on March 18, the eaglet had acquired the 12 to 14 pound weight and 7-foot wingspan of its parents.

According to Dorn Whitmore, outdoor recreation planner for the Wildlife Refuge, the Kennedy Parkway eaglet was one of five known to be hatched here during the just-ended nesting season. Four other nests were active during the year and two of them produced two eaglets each. The five fledglings for the year compare with seven in 1985 and 10 in 1984. The survival rate of hatchlings reaching adulthood runs about 50 percent.

Whitmore said the long-term prospects for the survival of the bald eagle — an endangered species — on the refuge is good. "We have a lot of old tall trees close to water and we're trying to manage the habitat." He indicated that the five to seven active

nests may be near the carrying capacity of the refuge.

Florida has been more fortunate than most states in retaining its eagles. Its estimated 350 breeding pairs represent the largest population in the United States with the exception of Alaska, which is estimated to have as many as 50,000 birds. Only 10 states are now believed to have more than 25 active nests.

But Florida's human population is growing and vigilance will be required if the nation's symbol is to remain a living presence in the state's skies.

"As Florida grows," predicted Whitmore, "additional waterfront areas will be developed. The long-term view in the state may be a decline."

The southern bald eagle is a sub-species found from Florida through North Carolina with a few wandering as far afield as Nebraska. Some are to be found in Florida on a year-round basis but peak populations are here in the winter when the food supply — consisting of fish and birds (cattle egrets, coot and ducks) is greatest.

Bald eagles are believed to live as long as 30 years in the wild and even longer in captivity. They mate for life; but if one dies, the survivor will accept a new mate.

Whatever the future may bring, the bald eagle is alive and well on the Kennedy Space Center and here — at last — its future looks bright.

NASA Features Aero-Space Plane, Research Pilots At EAA Convention

NASA returned to Oshkosh, Wisconsin, Aug. 1-8 for the 34th Annual EAA International Fly-In Convention and Sport Aviation Exhibition with a new exhibit entitled "21st Century Aviation." Other highlights of NASA's participation included special convention appearances by four flight research pilots and two Teacher-In-Space finalists.

Visitors to the NASA exhibit were treated to a glimpse of the future, including potential concepts for the National Aero-Space Plane Program, announced by President Reagan in his 1986 State of the Union address.

As envisioned, future hypersonic cruise vehicles would be capable of flying intercontinental ranges at high altitudes and very high speeds within the atmosphere, for example, reducing trip time from the U.S. West Coast to Tokyo to about 2 hours. The comparable subsonic flight takes more than 10 hours. A second major application would provide aero-space vehicles efficient and powerful enough to boost payloads and passengers to Earth orbit.

In a joint aero-space plane program with four Department of Defense agencies, NASA hopes to demonstrate technology for future hypersonic cruise and transatmospheric vehicles in a series of research flights beginning in the mid-1990's. Assuming aero-space plane technology is successfully demonstrated, the first operational vehicles would come sometime after the year 2000.

The three NASA aeronautics field centers supporting the Oshkosh exhibit this year were Langley Research Center, Hampton, Va.; Lewis Research Center, Cleveland; and Ames Research Center, Mountain View, Calif., which includes Dryden Flight Research Facility at Edwards Air Force Base.

Throughout the 6,000-square-foot exhibit, research tools and techniques needed for aircraft of the 21st Century were explored. Among the highlights were rapidly increasing computer capabilities:

- The Ames Center has a new supercomputer and simulation complex that soon will be capable of one billion computations per second. Complex measurements of aerodynamic flow fields that once took days or weeks will now take only minutes. The aerospace industry and universities also will use this resource.
- Advanced cockpits will make the most of computer technology. Aircraft displays may be touch-sensitive; aircraft controls may react to voice commands during peak work periods. The promise of a complete redesign of cockpits is generating increased interest in human factors research — how these and other projected technologies will affect pilot satisfaction and performance.

Other displays included a close look at rotorcraft research and potential applications. In addition, a variety of live and taped features were presented throughout the day in the Aerospace Theater. Outside the exhibit building was the popular AERO-VAN travelling exhibit.

NASA's aeronautical research was displayed in the agency's first exhibit of aeronautical art. Thirteen original works in a variety of media and styles were created by some of America's foremost artists through the NASA Art Program. Works included scenes from Chuck Yeager flying the X-1 to a model of the Space Shuttle in a wind tunnel for reentry tests. Artists whose works were represented in the collection included Ren Wicks, Stan H. Stokes, Nixon Galloway, William S. Phillips, Attila Hejja, Robert Schaar and Greg Mort.

For the second consecutive year, NASA's Goddard Space Flight Center, Greenbelt, Md., provided its SARSAT van, a mobile exhibit that presents an overview of the Search and Rescue Satellite system.

SARSAT is part of a multilateral cooperative program sponsored by the United States, Canada, France and the Soviet Union. The program's goal is to demonstrate the effectiveness of satellites in reducing the time needed to rescue air and maritime distress victims and significantly increase the possibility of saving lives. As of May 15, 1986, the number of lives saved had reached 576 — 244 marine, 311 air and 21 terrestrial — using up to five operational satellites over a 4-year period. The system has resulted in dramatically reduced rescue times and costs in most cases. The system is expected to become fully operational in 1990.

Another highlight of NASA's EAA Oshkosh 1986 involvement was the presence of four of the agency's research pilots, Warren G. Hall, Ames, Edward T. Schneider, DFRC, James M. Patton, Jr., LaRc, Earle O. Boyer, LeRc an iimportant element of flight research programs conducted at NASA centers around the country. The four appeared together in a special evening program and spoke individually at several forum talks throughout the week.

The agency's research pilots fly a mixture of missions in a variety of aircraft, ranging from atmospheric research over spewing volcanoes to new concepts of flight control for military fighters. Some of these pilots may be among the first to take America's aero-space plane to orbit. All of the agency's research pilots and their aircraft were featured as part of this year's NASA exhibit.

The Teacher-In-Space finalists were two of the ten chosen from among approximately 11,000 teachers for the agency's Teacher-In-Space Project. The two shared their experiences with young people and adults in several appearances during the EAA convention.

Finalist Robert Foerster is assigned to the Lewis Research Center as an educational consultant. Foerster is on leave from Cumberland Elementary School in West Lafayette, Ind., where he is a sixth grade teacher specializing in mathematics, science and computers. Finalist Niki Wenger is assigned to Langley Research Center. She is on leave from Vandevender Jr. High in Parkersburg, W. Va., where she teaches gifted and talented students.

More than two dozen other NASA speakers conducted technical forums throughout the convention, ranging from "Stall-Spin Research with Radio-Control Models" to "X-Wing: Developing Technology for a Supersonic Helicopter."

NASA Supercomputer System To Become Available Nationally

The world's most powerful supercomputer facility, the Numerical Aerodynamic Simulation (NAS) system, went on line to scientists and engineers throughout the country on July 21, 1986.

With the new system, more than 150 scientists from NASA centers, the Department of Defense, universities and industry began running research projects on the NAS supercomputer system located at NASA's Ames Research Center, Mountain View, Calif. The NAS supercomputer complex will be linked with 27 remote locations across the country through a combination of high-speed terrestrial and satellite links.

For example, the NAS will give a scientist at Colorado State University direct access to the world's most powerful computer system via his personal computer. He can run complex programs using the full capabilities of the NAS system, located about 1,000 miles away. These programs can include the sophisticated color graphic displays of computational results, one of the main features of the NAS system.

The NAS system is chartered to progressively incorporate the world's most advanced supercomputer technology into the NAS facility and serve as a pathfinder in supercomputing for government, industry and universities. Work on the NAS system began at Ames in the mid-1970's. Last September, the CRAY-2 supercomputer was installed as the main computational engine. The NAS CRAY-2 is unique in having a 256-million word memory (largest yet available) and can perform 250 million computations a second.

Ames expects to select the next generation superfast computer currently referred to as the HSP-2 (High Speed Processor-2), within the next year. This machine is expected to perform a billion computations a second. This will bring the NAS system closer to its near-term goal of having computers with a billion word memory and computational power of 4 billion calculations a second. A longer term goal is to have a 10 billion computations-a-second capability within a decade.

Start-up of the NAS involved a selection process which resulted in the choosing of 97 research projects to use the NAS resources. The majority of these projects focus on aerodynamics and hypersonic flight research. NAS will be one of the prime national centers involved in development of the NASA/DOD National Aero-Space Plane. Other NAS projects will include astrophysics, computational chemistry, weather modeling and other large-scale computation problems.

Scientists and engineers located nationwide will interact with the NAS system's CRAY-2 and supporting processors, such as the Amdahl 5840s and VAX 11/780s, by using a NAS-developed operating system that is based on the UNIX system. This operating system will allow scientists to use their own graphic displays to interact with the CRAY-2.

The NAS system will be relocated to a new computational facility in late 1986 and will be fully operational in March 1987 when it will almost double the number of scientists and engineers using the system.

Trials Don't Erase NASA's Proud Record

Like a grounded eagle, America's space program is gathering its strength, healing its hurt and preparing for the time when it will again soar as it was created to do.

Throughout KSC are the signs of a renewed determination to return humankind to its new space frontier, as the Center's leaders and work forces start on the road to recovery.

A new momentum is emerging during the launch stand-down period as the team's members analyze, streamline, document and implement the new thrust.

The Shuttle Processing Team at KSC, including thousands of men and women from NASA, contractor and support organizations that has justifiably been called "the finest Space Team ever assembled" now faces an opportunity to prove itself even better, said Bob Sieck, KSC's director of Shuttle Management and Operations.

In a message from former Center Director Richard Smith to employees, he said, "While NASA has accepted the responsibility for the 51-L accident and the criticism of design and management failures which led to the tragedy . . . It would be an additional tragedy to allow this critical barrage to cripple our self-confidence and obscure our many shining achievements since the agency was created nearly 28 years ago.

"NASA and its contractors have not merely done things right over the past decades, we have done virtually every thing we have been asked to do superbly. Great dreams, which were mere science fiction in NASA's youth, are now historical fact.

"We have orbited inquisitive satellites to study our Earth and the space around it. Space-age communications, made possible by orbiting relay stations, have brought the remotest corners of the Earth to within telephone range and spaceborne weather sensors mean destructive storms can no longer threaten human lives without warning.

"Spacecraft of ever increasing sophistication and capability have been launched with human crews to orbit the Earth and leave twelve sets of footprints at six far-flung locations on the Moon as witness of our ability to explore the space frontier. Robot spacecraft have soared past the inner and outer planets to help us better understand the mysteries of our Solar System.

"We were — and are — on the cutting edge of technology. Many of the techniques, the materials and the technology we have developed to fulfill our goals in space have been transferred to the domestic economy to permeate almost every facet of our daily lives.

"These technological miracles were not accomplished by faceless nonentities. They are the products of the daily efforts of this country's aerospace team . . . the things that all of us do when we come to work each day.

"It is a proud record. All of you may take pride in having played a role in writing some very prestigious pages in the history books . . . and we will be writing more!"

"During this recovery period," said Sieck, "our approach is similar to that of any team between seasons — work hard, train hard and further develop the tools which have been the foundation of the previous success."

And as the backlog of work that has developed over the years receives renewed attention, said Jim Rice, director of Center Support Operations, "Base Operation teams are now able to get to the on-line facilities and make the necessary modifications, improvements and perform routine maintenance.

During the stand-down, Sieck said, "We will focus on bringing the system closer to operational status, enhancing our work documentation systems, and improving our performance in many areas through additional training."

"Our payloads teams," said John Conway, director of Payload Management and Operations, "are working with renewed determination to demonstrate our ability both with Shuttle payloads and Delta vehicles. I am absolutely certain that we will emerge as a stronger and more capable organization in the future."

"We would like to erase that January day from our history," said Shuttle Launch Director Gene Thomas, but "there is still the pride that the Kennedy Space Center remains the world's foremost launch facility. There is still the determination that we will do our share in rebuilding our nation's confidence in NASA and its contractors. And there is still the same dedication of the world's greatest launch team that has been so successful in the past."

The performance of the KSC team always has been a source of pride to the team, the community and all involved in the space programs, observed Sieck. "After our next Shuttle launch, we will reflect back on this period and be thankful that we approached it with positive attitudes and aggressive efforts," he said.

From The Congressional Record

Senator George Mitchell (Maine), provided the following remarks concerning a possible joint mission to Mars.

In the years immediately ahead, the United States faces numerous crossroads. As a nation, we must confront issues — and hard choices — ranging from world trade to nuclear arms control.

The U.S. Space Program also faces major crossroads. In May, the report of the National Commission on Space, outlined possible challenges for us to pursue. We also have been reminded poignantly of the potential risks of those challenges, with the release of the report of the Presidential Commission on the Space Shuttle *Challenger* accident.

Major organizational changes now await NASA — along with a renewed commitment to safety, and design changes in the Shuttle Orbiter itself. But as the Rogers Commission pointed out in a "Concluding Thought" to its report, NASA and the Space Program are "a symbol of national pride and technological leadership.

The Commission applauded NASA's "spectacular achievements of the past" — and anticipated "impressive achievements to come."

One potential glimpse of achievements yet to come is provided by our colleague, Senator Matsunaga of Hawaii, in his recently published book "The Mars Project: Journeys Beyond The Cold War."

Senator Matsunaga's book is a statement of hope. It is a masterpiece of imagination and a blueprint for legislative determination. In one bold stroke, he addresses the need for the United States to retain our leadership in a global economy in the 1990's; the search for arms control and world peace; and the directions which our Space Program should follow.

"The Mars Project" challenges us to look beyond the arms race and the cold war to a joint, cooperative effort with the Soviet Union to launch a manned mission to Mars in the 21st century.

We already have taken first steps toward Mars. In 1976 — the year of the American Bicentennial — our Viking I and II space probes orbitted and landed on Mars. In 1988, the Soviet Union will launch an unmanned scientific mission to the Mars moon, Phobos. In 1990, the United States will launch its Mars Observer probe.

There is no reason why the United States and the Soviet Union should not coordinate these next two scheduled missions to Mars, and use them as a springboard to the future. Together, we can proclaim 1992 as an International Space Year — the same year as the 500th anniversary of the discovery of America by Christopher Columbus; the 75th anniversary of the Russian Revolution; and the 35th anniversary of both the launching of sputnik and the International Geophysical Year.

The United States and the Soviet Union already have cooperated in the 1975 Apollo-Soyuz mission. The achievements of our respective space programs also are complementary. The Soviets have extensive experience with long-duration space flights. Americans have landed men on the Moon.

A joint American-Soviet mission to Mars would proclaim a bold frontier for the entire world. It would look beyond the strategic defense initiative to a higher purpose. Instead of "star wars," we would embark on a "star trek" together. Instead of the destructive competition of the arms race, it would represent a constructive, cooperative competition with the laws of physics.

My home State of Maine already has called on the United States Congress and the Soviet Union to rise to the challenge of peaceful space exploration. On February 21, 1986, the Maine State Legislature adopted a joint resolution calling on our governments "to do everything within their power to commit their nations to participation in a joint Soviet-American manned space flight to the planet Mars."

In the spirit of the late Samantha Smith, the young girl from Maine who traveled in 1983 to the Soviet Union on a mission for peace and understanding, the resolution of the Maine State Legislature was carried to Moscow in April 1986 by a delegation of 77 Maine high school students and educators. Leading the delegation was Mr. William Fortschen, a teacher at Mountview High School, who previously had been one of Maine's five finalists for NASA's "Teacher in Space" — an honor which finally went to our neighboring State of New Hampshire's Christa McAuliffe, who of course perished in the *Challenger* accident.

On April 22, 1986, the Maine students visited the Cosmonautics Museum in Moscow and presented the Maine State Legislature's resolution to former Apollo-Soyuz Cosmonaut Alexei Leonov. They also presented him with a copy of Senator Matsunaga's book.

Four Soviet speakers attempted to link the proposal of a joint American-Soviet mission to Mars to the need for the United States to abandon the strategic defense initiative — saying that our nations cannot afford to pursue both.

But 13-year-old Dallas Brennan of Maine challenged the Soviet representatives, asking why they could not simply accept the proposal. The Maine State Legislature's resolution was presented by children representing the children of Maine — and the Mars Mission must not be a pawn in the arms race, but rather, as an aspiration and bond between the children of our two societies.

The Soviets were stunned — and impressed — by young Dallas' forthrightness. They then broke into smiling laughter and applause when 9-year-old Edith Webster, another member of the group, presented the Maine State flag to Cosmonaut Leonov — and asked him to please take it with him when he goes to Mars.

Cosmonaut Leonov will not live to travel to Mars. But the son or daughter of a Soviet cosmonaut very well may — and I can think of no greater achievement for our nations than if they are accompanied by one of our own American sons or daughters.

Like Senator Matsunaga and the Maine State Legislature, I endorse the proposal for an American-Soviet mission to Mars. We also are not alone, and we are bipartisan in spirit. Senators Mathias of Maryland, Pell, of Rhode Island, Proxmire of Wisconsin, Simon of Illinois, Kassebaum of Kansas, Stafford of Vermont, and Gorton of Washington, who chairs the Senate Commerce Committee's Subcommittee on Space, also support the concept.

A joint mission to Mars will provide an ideal opportunity for asserting the U.S. technological leadership. As Senator Matsunaga declares in his book: "Space is responsive to American instincts . . . American genius works best when it has room. American ingenuity thrives in the expansive physical environment of a new frontier."

A joint mission to Mars also represents a more prudent investment than the Reagan administration's strategic defense initiative — which again, as Senator Matsunaga writes, "will have no constructive economic application and might not even work. Space weapons systems won't provide infrastructure or constitute stepping-stones for space exploration and settlement. They will just sit up there in space, a trillion-dollar building block to nowhere."

It will cost the United States at least $8 billion to construct a space station by 1993. A manned Mars mission will cost $40 billion by one estimate. However, SDI would cost a hundred times that figure — and represent a tragic diversion of national resources.

On the other hand, a joint mission to Mars would spread the costs of space exploration. It would foster international cooperation and peace, not mutual distrust and the spectre of war.

Moreover, a joint American-Soviet mission to Mars will necessarily require the Soviet Union to join in open, democratic experiments. Again, as Senator Matsunaga so aptly points out: "Joint activity in space means open competition, which is inherently democratizing and favors free enterprise."

A joint mission to Mars would see levels of cooperation that elude us in other contexts. The 1975 Apollo-Soyuz Mission is a historical example. Its technical imperatives set precedents for openness, information exchange, coordination and verification — important issues which have otherwise defied resolution by our arms control negotiators.

We all share a hope for world peace. A joint mission to Mars could provide a vision of that peace.

Men and women must never cease to reach for the stars. Nations must never cease to reach out together in search of peace, in common spirit and purpose.

If not to ourselves, we owe this commitment to our children, and to future generations.

Presidential Management Improvement Awards

Vice President George Bush (right) recently presented 1985 Presidential Management Improvement Awards to a group of Langley Research Center employees. Jimmy H. Wilson (second from left), Robert R. Moore Jr., Joseph Getsug, Charles L. Crowder Jr., Kenneth N. Cole and James R. Dinkins were recognized for "their initiative and innovativeness in negotiating a contract with the local power company which led not only to a reduction in electrical power costs, but also to increased flexibility in the operation of major research facilities, thus saving the Government $5,700,000." The Vice President made the presentation on behalf of President Reagan, who annually authorizes such awards for federal and military personnel whose achievements during the fiscal year produced substantial benefits to the American people. The Langley group was one of eight groups and 11 individuals receiving awards for helping save American taxpayers more than $270 million. Accompanying the group to Washington, D.C., for the ceremony was Langley Director Richard H. Petersen (left).

Scientist Revolutionizes Making Of Sunglass Lenses

A NASA Ames research scientist has discovered a chemical process which has revolutionized the making of sunglass lenses. His new invention, utilized by a noted sunglass worker, holds the NASA record for the most units made and sold under a NASA license.

Theodore J. Wydeven, Jr., Ph.D., a physical chemist at Ames Research Center, discovered this process while working on another problem. Wydeven had a need to improve the thin semipermeable membranes of a spacecraft water purification process. One of the best ways to do this was to coat a proous filter with a thin plastic semipermeable film, using an electric discharge of an organic vapor.

Wydeven's process of depositing a thin plastic coating upon another dissimilar plastic sheet apppeared to have practical applications. As a result, this process was a key, according to the scientific and commercial communities, to resolving other problems. The sunglass manufacturers had a problem.

In the eyeglass makers' industry, ground and polished tempered glass has been the traditional and ideal lens. However, in recent years, the many virtues of polarized and other plastic lenses have been explored. Plastic lenses have excellent optics and better absorption of dangerous ultraviolet radiation. In addition, they are resistant to shattering, easy to shape, lightweight and more comfortable to wear than glass. But the major problem with plastic lenses is their susceptibility to scratching. After a few wipes and a few wearings of sunglasses with plastic lenses, a haze may appear which greatly reduces visibility.

A similar problem also exists with plastic space helmet visors. Through his research, Wydeven discovered an abrasion resistant coating and process for polycarbonate visors, and this is when one sunglass maker became more than interested in the scientist's invention.

Foster Grant Corporation, Leominster, Massachusetts, one of the world's largest manufacturers of non-prescription sunglasses, obtained a NASA license to use the Wydeven process in 1983. Under the license, the Foster Grant Corp. has used the process to coat over five million pairs of sunglasses in less than three years. These sunglasses are sold under the trade name of "Space Tech" and have generated approximately $75,000,000 in retail sales. The Space Tech sunglasses sell at most local retail outlets at a moderate price of about $15. The Space-Tech Lens not only holds the NASA record for the most units made and sold under a NASA license, but it will also stand up under normal wear five times longer than the most popular available plastic lenses. The coating process used is referred to as glow discharge or plasma polymerization. The compounds utilized in the procedure process are organosilanes which are plasma polymerized and then treated for a short time with an oxygen glow discharge to increase hardness or scratch resistance.

Did You Know?

J. Ray Dagenhart, an aerospace engineer in the Transonic Aerodynamics Division at NASA's Langley Research Center, was awarded the Floyd L. Thompson Fellowship for 1986-87 to study at Arizona State University.

The Thompson Fellowship Program was established in 1977 to encourage the development of research potential among the Langley staff. The fellowship allows researchers who have demonstrated continued growth in research to spend up to 12 months at an educational or research institution. It is named in memory of Dr. Floyd L. Thompson, Langley Director from 1960 to 1968.

At Arizona State, Dagenhart will conduct detailed experiments to measure the formation and growth of crossflow vortices on swept-wing surfaces. He will be working with Dr. William S. Saric, internationally known for his contributions to both experimental and theoretical boundary-layer stability research. "We will experimentally examine the transition from laminar to turbulent flow on swept wings. The three-dimensional flow over swept wings produces a layer of vortices which can interact with other instability models to cause early transition," explained Dagenhart.

"The formation and growth of these vortices will be measured and time-dependent velocity measurements will be made using multiple hot-wire probes. In addition, the flow field will be visualized by using various scientific techniques," he said. "This investigation should yield important insight for use in the design of future swept laminar-flow wings for low-drag application."

In his work at Langley, Dagenhart conducts experimental and theoretical research in support of the Laminar Flow Control experiment in the 8-Foot Transonic Pressure Tunnel. His assignments have included development and application of boundary layer stability analysis codes, design and conduct of the Gortler Vortex Experiment in the Low-Turbulence Pressure Tunnel, design of low-interference turbulence probes and calibration of suction flow measurement nozzles.

Dagenhart said that the proposed research activity directly supports two important Langley goals: viscous drag reduction and theoretical code validation. "During my stay at ASU, I expect to combine advanced measurement techniques and theoretical disturbance interaction predictions to produce a better understanding of the transition process on swept wings," he said.

Forty college engineering and science students were exposed to wide-ranging research at NASA Lewis Research Center in a summer program aimed at assuring a continuous stream of top talent for NASA as well as helping to alleviate a national shortage of such skills.

Participants in the four-year-old NASA-wide program were recommended by minority/female advancement programs at the universities and by an innovative program in which Lewis senior managers actively recruited students from their (managers') alma maters.

During the three-month period from early June to late August, the students worked on a research project so that their textbook knowledge may become practical experience. Lewis engineers and scientists worked alongside the students monitoring their progress.

"We attempted to match the research project to the student's individual talent, ambition and degree program objectives," explains Judy Montfort of the Lewis Equal Opportunity Programs Office who has headed the program since its inception. Hands-on training for the 40 engineering and science aides was augmented by specialized instructions and lectures on their assigned projects. The students were expected to make real research contributions as they proceeded. Colleges and universities represented in the program this year were Case Western Reserve University, Georgia Institute of Technology, Prairie View A&M University, Massachusetts Institute of Technology, Purdue University, Rensselaer Polytechnic Institute, University of Washington, Central State University, Illinois Institute of Technology, Spelman College, Hampton Institute, Cornell University, Southern University, University of Puerto Rico and Tennessee State University.

Two flight research and simulation computers used at NASA Ames-Dryden Flight Research Facility have been donated to Tuskegee University, Tuskegee, Alabama, by the space agency in recent ceremonies at Tuskegee. Representing NASA at the turnover ceremony were Dr. William F. Ballhaus, Jr., Ames Research Center director and Mr. Chuck Brown, Ames-Dryden Information and Simulation assistant branch chief.

The two ModComp Classic 7870 computers were accepted by Tuskegee University President, Dr. Benjamin Payton and Dr. Vasscar Harris, dean of the university's School of Aerospace Science.

The computers, which supported Ames-Dryden real time flight testing and "pilot and flight hardware in-the-loop simulation testing" from 1981 to 1985 will be used to support the university's aerospace program. NASA was able to donate the computers when they were replaced by high speed interactive Gould Sel computers.

The ModComp computers provide one megabyte of memory in each central processing unit. Each CPU has 32 analog to digital conversion channels, 96 digital to analog conversion channels and 96 input/output discrete channels.

"This donation will help strengthen and ensure a lasting and mutually beneficial relationship between Ames Research Center and Tuskegee University," said Brown.

A new model in honor of the late Dr. Judith A. Resnik, NASA Mission Specialist and a member of the Society of Women Engineers, was announced by the Society. The decision came during a meeting of the Board of Directors of the Society at the Kansas City Hyatt Regency Hotel, June 1, 1986. The medal, the Resnik Challenger Medal, will be awarded to a woman engineer for "visionary contributions to space exploration."

The medal will recognize obvious merit and significant contributions by an individual who has expanded the horizons of space exploration through engineering breakthroughs in aeronautical, astronautical, materials, electronics, ceramics, structural, bio-medical, or other space associated engineering. The award could be made to a woman engineer who has been practicing for ten or more years and meets the other qualifications. The entire engineering community including technical societies, engineering industries, academia, or individual engineers can nominate qualified candidates for the medal.

The NASA Headquarters Publications Branch has won many Blue Pencil Awards for Excellence for educational publications.

The branch has won First Place engraved plaques, and Second Place, Third Place, and Honorable Mention certificates in almost all of the fifteen categories in Government-wide competition over the years.

This year the Publication Branch has won First Place: Publication for general audience (four color) *NF-143 Magellan;* Honorable Mention: General brochure (one color) *Teacher In Space Lesson Plans;* Honorable Mention: Technical audience (two or three color) *Graduate Student Researchers Program 1986;* Third Place: Visual design *WAL-118 International Cometary Explorer.*

The National Association of Government Communicators was organized in 1961. It is a professional body of writers, editors, and information personnel whose responsibility is the effective presentation of media communications and Federal programs to the public.

The National Association of Government Communicators strives to:

1. Unite those engaged in creating and disseminating information concerning the Government.
2. Establish and promote high standards of individual professional and public service.
3. Develop an awareness that the professional communicator is an integral part of the decision and policy-making process.

Forty-six NASA Langley Inventors who received United States patents in 1985 and recipients of Langley's Technology Utilization Transfer awards were honored at a annual Inventors' Luncheon Tuesday, April 20. William D. Mace, Director for Electronics at the Langley Research Center, presented the awards to the following employees: (Pictured from left, first row): Robert J. Swaim, William J. Debnam, Jr., Linda B. Blackburn, Anne K. St. Clair, Diane M. Stoakley, Dr. Jag J. Singh, Robert F. Berry, David F. Johnson; (second row): Harold G. Bush, Harold D. Burks, John R. Ellingsworth. Ronald A. Outlaw, Dr. Leonard M. Weinstein, James F. Meyers, Richard W. Barnwell, Robert J. Fox; (back row): Dr. Terry L. St. Claire, Allan H. Taylor, Dr. Joseph S. Heyman, Timothy E. Hepner and Martin M. Mikulas.

The formation of a NASA Alumni League has been created to support the goals, objectives, programs and activities of the National Aeronautics and Space Administration as outlined in the National Space Act of 1958.

Membership is open to anyone who has ever been a NASA employee.

According to Robert C. Seamans, Chairman of the League's Board of Directors. "The Alumni League is committed to the principle that America's civil space program is fundamental to the evolution of the human spirit, to the healthy progress of civilization and to a strong United States. The League will have close ties with NASA and will strive to assist the agency in its endeavors, while maintaining independence in policy matters."

Alumni League President, Gerald D. Griffin said. "The League is committed to restoring public appreciation of the value, accomplishment, challenge, risk, and adventure that characterize space activity. We are prepared to provide advice, counsel, and comment on key space issues. We intend to work closely with the private sector, the media, the Congress, and the Executive Branch in focusing the expertise for our members in the Nation's interest."

The League will be governed by a Board of Directors.

Revenues to support League activities will come from annual membership dues, which are tax deductible. Membership categories are: individual, $30; supporting, $100; sustaining, $250; life, $500; or benefactor and life, $1000.

Any eligible person interested in becoming a member should write NASA Alumni League, 600 Maryland Avenue, S.W., West Wing Suite 203, Washington, D.C. 20024.

NASA, in conjunction with DOE and DOD, sponsor the Interagency Advanced Power Group (IAPG), whose main purpose is to promote the exchange of information and avoid duplication of R & D efforts among federal researchers in advanced power fields. One way members of the IAPG coordinate their information exchange is by attending semi-annual meetings of IAPG Working Groups/Panels. These include: Auxiliary Components, Chemical, Heat Engines, Magnetohydrodynamics (MHD), Nuclear Power Conditioning, Solar Photovoltaic, Solar Thermal, and Systems. Recently, a new IAPG Pulse Power Panel was initiated to focus on power systems capable of producing large electrical pulses for a wide range of applications. Members of the panel will meet on October 28, 1986 to exchange information on the status of federally-sponsored research in this area—research such as devices under consideration for SDI, propulsion systems, and research and test equipment.

The high level of interest in this technology is reflected in the enthusiastic response to the formation of this panel. Since April, 1986, when the panel was officially initiated, 48 members and observers have joined.

Would you like to learn more of what's going on in this research field?

Do you see the benefit in sharing your research accomplishments with others in-house as well as outside of your research community?

The IAPG set up the Power Information Center to distribute periodic publications, coordinate semi-annual meetings and maintain a data base of projects in chemical, electrical, mechanical, nuclear, solar, and systems R&D. Membership is *FREE* to employees of the IAPG member agencies.

For further information on participation in the Pulse Power Panel, attending the October 28 meeting, or the IAPG, contact Judi Decker, Program Coordinator, or Liz Feinberg, PIC Manager, at (202) 842-7600

NASA has formed two teams to review Space Station design and work package assignments and functions.

A Space Station Configuration Critical Evaluation Task Force, headed by W. Ray Hook, Manager, Space Station Office at NASA's Langley Research Center, Hampton, Va., will conduct a technical review of Space Station architecture and systems. The task force will conduct their activities at Langley. An Executive Technical Committee, headed by Andrew J. Stofan, will provide oversight and guidance to the task force and will assess the impact of any design modifications or changes on individual NASA center and contractor roles.

Stofan's actions are in response to NASA Administrator James C. Fletcher's July 31 directive to conduct a thorough review of all aspects of Space Station design and to hold off the implementation of work package realignment for a period of up to 90 days.

Approximately 35 people will serve on the task force full time, several hundred more will take part in the technical evaluation, including NASA personnel from the work package centers and from outside of the program, Phase B contractors, and representatives from user groups and the international partners.

Astronaut Frederick (Rick) Hauck was named Deputy Associate Administrator for External Relations effective August 11.

In this position, Hauck will share responsibility for policy level management, direction and coordination of the agency's relationships with public and private organizations both domestic and international. This includes the news media, other federal agencies, state and local governments, foreign governments, international agencies, industry and private individuals.

A Navy captain, Hauck was selected as an astronaut candidate by NASA in January 1978. He was commander of STS-51A and pilot for STS-7. He also was a member of the support crew for STS-1 and re-entry capsule communicator on the support crew for STS-2.

Born April 11, 1941, in Long Beach, Calif., Hauck received a bachelor of science degree in physics from Tufts University in 1962 and a master of science degree in nuclear engineering from the Massachusetts Institute of Technology in 1966.

A Navy ROTC student at Tufts, he served 20 months as communications officer and combat information center officer aboard the destroyer USS Warrington. After receiving his wings in 1968 from the Naval Air Station in Pensacola, Fla., he flew 114 combat and support missions in Southeast Asia while stationed aboard the carrier USS Coral Sea. In 1970, Hauck was selected for test pilot training at the U.S. Naval Test Pilot School, Patuxent River, Md.

Hauck has flown various aircraft including the A-6, A-7 and F-14. He has been awarded 9 Air Medals, the Navy Commendation Medal with Gold Star and Combat V and the NASA Space Flight Medal. He also was named Outstanding Test Pilot for 1972.

Captain Hauck is married and has two children.

William H. Dana was appointed Chief Pilot at NASA's Ames-Dryden Flight Research Facility. He has been with NASA since 1958 as an aerospace research pilot. Dana is shown with the X-15 rocket-powered research aircraft, which he flew 16 times, reaching a top speed of 3,897 miles per hour and a peak altitude of 310,000 feet (almost 59 miles high). He also flew wingless lifting bodies, forerunners of the Space Shuttle and has flown many other NASA research craft. Dana is a member of the Lancaster-based Society of Experimental Test Pilots.

Lt. Gen. Forrest S. McCartney, Commander of the Space Division, Air Force Systems Command, Los Angeles, was named Director of the Kennedy Space Center, Fla. On assignment from the Air Force, he is expected to report to NASA on approximately October 1.

Born March 23, 1931, in Ft. Payne, Ala., McCartney received a bachelor of science degree in electrical engineering from the Alabama Polytechnic Institute, Auburn, in 1952 and earned a master's degree in nuclear engineering from the Air Force Institute of Technology, Wright-Patterson Air Force Base, Ohio, in 1955. He also is a graduate of the Armed Forces Staff College, Norfolk, Va.

McCartney's Air Force assignments have included the Satellite Control Facility, Sunnyvale, Calif., as a satellite controller during early space operations; the Office of Space Activities, Headquarters Air Force Systems Command, Andrews Air Force Base, Md., as a project officer in the Titan III program and various Air Force communication satellite programs; the Directorate of Space at Headquarters U.S. Air Force, Washington, D.C., as the program element monitor for satellite communications programs and other selected space-related efforts; and the Air Force Eastern Test Range, Patrick Air Force Base, Fla., as director of range engineering.

In June 1974, McCartney was assigned to the Space and Missile Systems Organization at Los Angeles Air Force Station as the systems program director for Fleet Satellite Communications Systems. In August 1976, he was reassigned within the organization as deputy for space communications systems.

McCartney moved to Norton Air Force Base, Calif., in September 1979, as vice commander of the Ballistic Missile Office and was named commander of the Ballistic Missile Office and M-X program director in November 1980. He became vice commander of the Space Division in May 1982 and commander, Space Division and vice commander, Space Command in May 1983. Upon activation of the U.S. Space Command, he was redesignated commander of the Space Division in October 1985.

His military decorations and awards include the Distinguished Service Medal, Legion of Merit with one oak leaf cluster, Meritorious Service Medal and Air Force Commendation Medal with three oak leaf clusters. He also wears the master missile badge and the master space badge.

The following is an informal listing of organizations, officially reported to NASA, established following the 51-L accident.

Space Shuttle Children's Fund: American Security Bank, 1501 Pennsylvania Ave, Washington, DC 20005.

NASM Building at Dulles Airport, which will house the Enterprise. The building is to be called Challenger Hall.

Challenger Fund: P.O. Box 51-L, Colorado Springs, Sponsored by the U.S. Space Foundation, P.O. Box 1838, Colorado Springs, CO 80901.

Challenger Fund: % The Space Foundation, P.O. Box 58501, 711 Bay Area, Suite 300, Houston, TX 77058.

Space Camp/Challenger Memorial Fund: Scholarships for underprivileged children to the Space Camp in Huntsville.

USA Challenger Scholarship Foundation, L. I. Hanson, P.O. Box 681053, San Antonio, TX 78269.

Resnik Memorial Scholarship Fund: University of Maryland.

Resnik Scholarship Fund: Akron Public Schools, 704 North Broadway, Akron, OH 44308.

Resnik Scholarship Fund: Carnegie-Mellon University, 603 Warner Hall, Pittsburgh, PA 15213.

Judith Resnik Endowment: American Association of University Women, AAUW Endowment, 2401 Virginia Avenue, NW, Washington, DC 20037.

Challenger Benefit Fund: % Texas American Bank, Trust Division, P.O. Box 2529, Houston, TX 77252.

Reach for the Stars 89: Box 2180 Ventura, CA. 93001.

Teacher in Space Education Foundation: 1110 Vermont Ave., NW, Suite 710, Washington, D.C. 20005.

Onizuka Memorial Committee, P.O. Box 1927, Kailua-Kona, Hawaii 96745; 808/329-1634.

Challenger Center for Space Science Education, 1550 West Bay Area Blvd., Suite 102, Houston, TX 77258-8000.

Ron McNair Committee, P.O. Box 663, Lake City, S. C. 29560.

Ronald E. McNair Scholarship Fund: Established at North Carolina A&T State University, Greensboro, NC.

Ron McNair Scholarship Foundation: P.O. Box 54281, Atlanta, Ga. 30308.

Astronauts Memorial Foundation, Inc.: P.O. Box 628003, Orlando, FL 32862-8003.

Space Flight Memorial Foundation, JSC: P.O. Box 58009, Houston, TX 77258-8009.

The first anniversary of the International Cometary Explorer (ICE) intercept of a comet was spotlighted at Washington, D.C.'s National Air and Space Museum on Sept. 11 in a six-part symposium on deep space gymnastics.

Sponsored by NASA's Goddard Space Flight Center, Greenbelt, Md., the symposium featured six presentations by university, industry and government scientists and engineers explaining the physics and techniques for maneuvering spacecraft to gather valuable scientific data through planetary swingbys and interplanetary coasting.

Among the symposium participants was Robert W. Farquhar, an engineer from Goddard who described his role in the historic intercept of Comet Giacobini-Zinner by the ICE spacecraft on Sept. 11, 1985.

In this unprecedented encounter, Farquhar "threaded" the ICE spacecraft—travelling at a speed of 46,000 miles (74,000 km) an hour—through the tail of the comet while it was 44 million miles from Earth.

The data from that mission both added significantly to and confirmed many predicted features of a comet.

The encounter was the zenith of a 7-year odyssey through space for the ICE—launched in 1978 as the International Sun-Earth Explorer (ISEE))—which Farquhar maneuvered past the Moon five times in 1983, using lunar gravitational assists to "slingshot" the spacecraft toward its rendezvous.

Other speakers included Dr. William I. McLaughlin, manager, Mission Profile and Sequencing Section, Jet Propulsion Laboratory, Pasadena, CA.; Roger E. Diehl, Jet Propulsion Laboratory; Chauncey W. Uphoff, private consultant and Dr. Kathleen C. Howell, assistant professor, School of Aeronautics and Astronautics, Purdue University.

New Horizons Mentors

Langley Research Center employees who have served as mentors for the New Horizons Magnet Program at the New Horizons Technical Center were honored at a reception June 17. The mentorship experience began in December 1985 for students from the center, Langley's adopted school, to spend a portion of their academic instruction in a real-work situation with a NASA volunteer. At the reception the students and staff expressed their appreciation to the NASA mentors: (front row, from left) Shelley Canright, magnet program coordinator; Robert Daugherty; Victor Carreno; Jeff Cleveland; Salvatore Bavuso; Linda Haugh; David Dress; Robert Miserentino; Dick Hellbaum; (back row) Michael Hart; Katherine Smith; Jose Ortiz; Dr. Alan Pope; Dr. Robert Kilgore; Bill Kahlbaum; and Dennis Bushnell. Mentors unable to attend the reception were Richard Margason, Grace Liu, William Henderson, Wallace Sawyer, Dana Dunham, George Ficklen, Dr. Charles Byvik, Don Soloway, Dr. Pat Murphy, James Dezern, Dr. Wolf Elber, Sheila A.T. Long, John Wagner, Roane Hunt, Chris Glass, Stan Cole and Dr. Manuel Stein. The program will continue in September with new high school students and new NASA mentors.

Contractor News

NASA selected **Sverdrup Technology, Inc.,** Tullahoma, Tenn., for negotiations leading to the award of a cost-plus-award-fee contract for technical support services at NASA's National Space Technology Laboratories (NSTL), Bay St. Louis Miss.

Sverdrup's proposal reflected a proposed cost of approximately $45 million for a period of 3 years beginning in the fall of 1986. The contract will provide for a total period of performance of up to 8 years, consisting of the basic contract year, two 1-year priced options and five 1-year unpriced options. As proposed by Sverdrup, the total contract has a potential overall estimated cost of approximately $105 million. Each of the first 3 years also includes price options for additional effort.

Technical support services covered by the contract consist of test complex services for Space Shuttle main engines, engineering services, laboratory and field services, and data services for NASA and 18 other government agencies located at NSTL.

The contract will be managed by NSTL.

NASA selected **TRW, Inc.,** Redondo Beach, Calif., for negotiations leading to the award of a contract for the full-scale design, development, test, verification and delivery of the Orbital Maneuvering Vehicle (OMV) flight vehicle including its Airborne Support Equipment (ASE), Ground Support Equipment (GSE), Ground Control Station (GCS), spares, tooling and support equipment. Included in the effort are plans and operations associated with the Design, Development, Test and Evaluation (DDT&E) for one flight Grumman Aerospace Corp., Bethpage, N.Y., and SPAR Aerospace Ltd., Weston, Ontario, Canada, are team members.

The OMV is a reusable, remotely-operated propulsive vehicle that increases the range of the Space Transportation System. The primary uses of the OMV will be spacecraft delivery, retrieval, boost, deboost and close proximity visual observation beyond the operating range of the Space Shuttle. In addition, the basic vehicle will be configured in a way that will be readily adaptable to support Space Station activities.

TRW's proposal, including a priced option for one additional vehicle, reflected a proposed cost of approximately $205 million. The contract will be on a cost-plus-award-fee basis. Anticapted basic period of performance will cover approximately 5 years.

The OMV contract will be managed by NASA's Marshall Space Flight Center, Huntsville, Ala.

NASA's Marshall Space Flight Center, Huntsville, Ala., awarded a 7-month, $93,000 contract to **Martin Marietta Corp.,** New Orleans, to study the feasibility of converting a Space Shuttle external tank to an orbiting telescope.

According to Max Nein, advanced systems division at Marshall, the proposal to transform the external tank into a Gamma Ray Imaging Telescope (GRIT), to study gamma ray sources in the Universe, appears possible. Studies have determined that the spent tanks, 154-feet and 27.6 feet in diameter, could be carried into orbit rather than discarded just before the Shuttle achieves orbit. Components of the telescope would be carried in the Shuttle's cargo bay along with other payloads. Because the telescope would require periodic maintenance, it probably would orbit near the planned Space Station, 230 to 345 miles above Earth. The proposal was initiated by Dr. David Koch, Astrophysical Observatory, Smithsonian Institution, Cambridge, Mass.

"Once in space, residual propellents would be expelled from the tank and astronauts could assemble telescope components within the liquid hydrogen tank. They could enter the tank via an existing 36-inch aft manhole port or through tank modification. The tank then would be pressurized to provide the needed environment for the gamma ray detection technique," Nein said.

In operation, gamma rays would be converted by a lead plate into positions and electrons which travel the length of the telescope emitting light. The light would be imaged onto a detector by a large mirror spanning the diameter of the tank. Since gamma rays reflect the highest energy processes, gamma ray astronomy is essential to understanding the evolution of stars and the Universe and to the physical processes occurring in pulsars, quasars and black holes.

Nein said NASA plans to conduct a separate gamma ray survey using the orbiting Gamma Ray Observatory (GRO). The Gamma Ray Imaging Telescope would follow up the work of the GRO by enabling NASA to conduct even more detailed gamma ray studies.

"We hope the feasibility study now in progress will help us learn more about meeting the scientific and engineering challenges related to turning the external tank into a valuable resource for the space-based study of gamma ray astronomy," Nein concluded.

Martin Marietta manufacture the Shuttle external tank under contract to MSFC, at NASA's Michoud Assembly Facility, New Orleans, where the study is being performed.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Bone Analyzer

One of the dangers of long-duration space flight is disuse osteoporosis, a form of bone deterioration induced by astronaut inactivity under weightless conditions. However, the crew of the Skylab 4 interim space station demonstrated, on an 84-day mission in 1973, that adequate food and exercise can reduce bone loss. Contemplating future manned missions that might run two years or more, NASA sought a practical, inexpensive, noninvasive way of making quantitative measurements of bone stiffness and mass, a system sensitive enough to monitor and evaluate small changes. This would enable comprehensive studies of the effects of nutrition and exercise, toward developing food/exercise programs to prevent astronaut bone loss. Since bone deterioration affects a substantial portion of the U.S. population, it would also meet a need — in hospitals clinics and convalescence homes — as a tool for diagnosis of bone abnormalities caused by disease, aging and disuse, and a means of evaluating fracture healing.

Such a system is now in final development status after a decade of effort by the Biomedical Research Division of Ames Research Center, which funded and teamed with Dr. Charles R. Steele, Professor of Applied Mechanics at Stanford University's Department of Aeronautics and Astronautics. In 1977, the Ames/Stanford team developed a prototype microprocessor-controlled bone probe system; built by Oxbridge Associates, Sunnyvale, California, it was known as SOBSA (Steel-Oxbridge Bone Stiffness Analyzer). Tests with human subjects indicated that SOBSA could be used clinically but it had certain limitations with respect to accuracy, sensitivity and operator training requirements. Through its Technology Utilization Program, NASA funded construction of an advanced SOBSA-2 featuring improvements in those areas.

SOBSA-2 is a computer-controlled impedance probe system in which bone stiffness is determined quantitatively by measuring responses to an electromagnetic shaker. The subject's bone is constrained at each end (below), the shaker applies vibration and the probe measures the resulting impedance (electrical resistance), providing a basis for computer analysis and determination of bone stiffness. Such information can be used by physicians to detect the presence of bone disease, to measure the extent of deterioration, and to aid in prescribing therapy.

SOBSA-2 has been further refined and it is now undergoing clinical testing at Stanford University Orthopedic Clinic, performing measurements on patients before and after total hip, knee, shoulder and elbow replacements. The latest model has a more powerful controller, permitting extensive data collection and analysis in a short time. By the end of year, it is expected that the system will have demonstrated the desired accuracy and repeatability over a wide range of subjects.

* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

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NASA Activities

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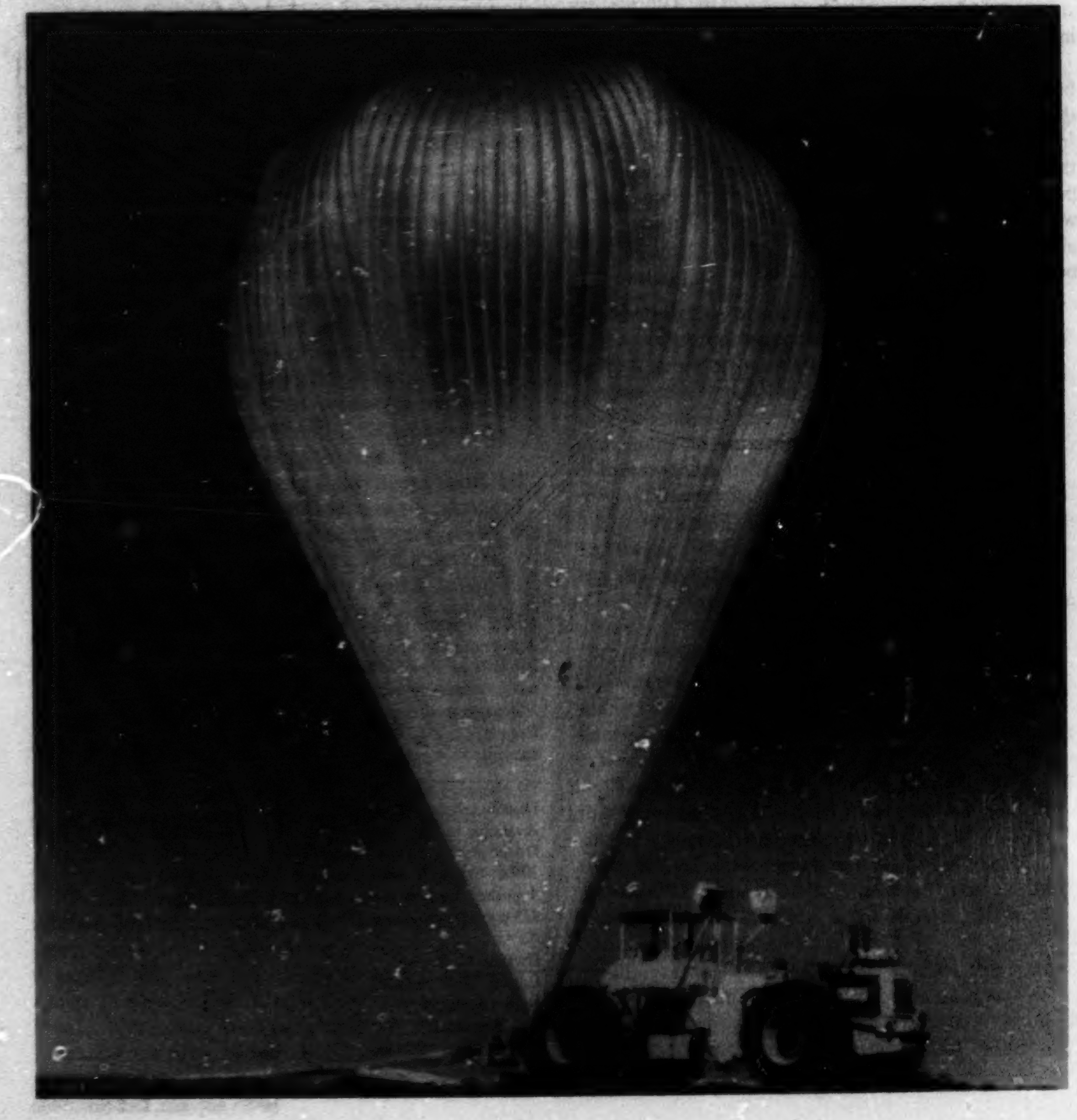
Vol. 17, No. 10 & 11



NAS 1.46:

A 28.4 million cubic feet volume balloon, carrying a 3000 pound payload, utilizing a newly developed balloon grade film designated "Astrofilm 'E'," was successfully launched on June 12, 1986 from the National Scientific Balloon Facility, located near Palestine, Texas. This flight was conducted as part of NASA's Balloon Program which is managed by the Wallops Flight Facility/Goddard Space Flight Center.

The NASA Balloon Program provides support for approximately 50 flights per year to the High Energy Astrophysics, Astronomy, and Upper Atmospheric Research disciplines as well as non-NASA support science programs both national and international.

The balloon, partially filled with helium gas, is held to the ground by the spool-release vehicle. On the ground, the helium occupies only a small fraction of the balloon volume. After release from the spool, the balloon will rise, lifting the scientific payload. As the altitude increases, the helium gas will expand until it reaches the "float" altitude above 1,000,000 feet. The fully inflated balloon will be many times the volume shown in the photo.

Contents

NASA Selects Investigations for Comet Rendezvous Mission .. 3
New Space Astronomy Technique Developed To Study Celestial Bodies 4
Langley Employees Receive IR-100 Awards 4
The Future Spacesuit 7
From the Congressional Record 9
Robots Of The Future? 10
NASA And You 11
National Space Transportation System Manifest 12
Did You Know? 15
Contractor News 19
Another Dividend From Air And Space 20

NASA Activities is published monthly by the National Aeronautics and Space Administration for the information of the agency's employees. Contributions and recommendations are solicited from Headquarters and field centers and should be addressed to Editor, NASA Activities, News and Information Branch, Code LFD-2, Washington, D.C. 20546. Material submitted for publication cannot be returned.

Distributed free of charge only to current agency employees. Available by subscription from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Check or money order should be made payable to Superintendent of Documents, GPO. Subscription rates are $23.00/year, domestic; $28.75/year, foreign.

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NASA Selects Investigations for Comet Rendezvous Mission

NASA has selected 38 possible investigations for the Comet Rendezvous Asteroid Flyby (CRAF) mission planned for launch in the early 1990's. The mission is designed to send an unmanned U.S. spacecraft to rendezvous with a comet, fly in formation with it for 3 years and fire an instrumented penetrator into the comet's nucleus. The spacecraft also will make close flybys of two asteroids on its way to the comet encounter.

The announcement was made by Dr. Burton I. Edelson, Associate Administrator, Office of Space Science and Applications, who stated, "this selection is particularly important in that it signifies NASA's commitment to the planetary mission strategy recommended by the Solar System Exploration Committee in 1983. The CRAF mission will be the first of a series to utilize a new planetary-class spacecraft, the Mariner Mark II, designed for missions beyond the orbit of Mars. These, together with the planetary observer missions to the inner planets, symbolize our commitment to a strong program in planetary science and exploration."

The CRAF mission will conduct a detailed study of the composition and physical properties of the comet nucleus and will observe changes that occur as the comet approaches the sun. Other mission objectives include analysis of the gas, dust and plasma comprising the comet's atmosphere and measuring the size, shape and surface properties of the asteroids. The CRAF spacecraft will carry 11 to 14 instruments including cameras, dust analyzers and a nucleus penetrator. Results from a 2-year instrument accommodation study will determine the final payload composition.

The scientific goal of comet and asteroid research is to advance man's understanding of the early solar system history by studying those objects believed to have undergone little change since the system was formed.

Several comets and asteroids have been considered as possible targets for the CRAF mission. The baseline plan calls for the CRAF spacecraft to be launched in late 1992 into an orbit about the sun.

After making observations during a flyby of the asteroid Malautra in mid-1993, the spacecraft will swing by the Earth again and a gravity-assist maneuver will boost the spacecraft to the orbit of comet Tempel-2. Following a flyby of asteroid Hestia, rendezvous with the comet will occur in late 1996 near the orbit of Jupiter.

The spacecraft's propulsion subsystem, planned to be provided by the Federal Republic of Germany, will slow the spacecraft and place it in the same orbit as Tempel-2. The spacecraft will fly in close formation with the comet for 3 years, first observing its quiet phase when distant from the sun and then observing the formation of the coma, dust and plasma trails as the comet nears the sun and becomes active. In 1997, the spacecraft will target and release an instrumented probe to penetrate the surface of the comet's nucleus and to make direct measurements of its composition, temperature and surface structure.

Tempel-2 is a short-period comet that circles the sun once every 5½ years, from near the orbit of Mars out to the orbit of Jupiter. If, for some reason, the CRAF mission cannot be launched in time for the planned Tempel-2 rendezvous, other suitable target comets and asteroids have been identified.

The penetrator is a pointed, spear-like projectile designed to penetrate the comet's nucleus to a depth of up to 1 meter. It will carry five instruments: a gamma-ray spectrometer to measure the elemental composition of both ice and non-volatile material; an accelerometer to measure the strength and structure of the surface; thermometers to measure the temperature profile with depth and thermal conductivity; a calorimeter to detect phase changes as an ice sample is heated; and a gas chromatograph to determine the amounts and types of gaseous molecules released from the ice sample.

Dr. William Quaide, Chief Scientist, Solar System Exploration Division, said "clearly, the most exciting aspect of this mission is the penetrator package. No one has ever sent a projectile into the nucleus of a comet."

Comets are thought to be the most pristine and unaltered samples of the early solar system, and many scientists believe comets may contain remnants of the primordial matter from which the solar system formed.

The most accepted model of a comet nucleus is the "dirty snowball" model, a mixture of ices, silicate minerals and possibly metals. The ices are solid, frozen substances that usually are liquids or gases under more familiar conditions. These may include water, methane, carbon dioxide, ammonia and more exotic species.

Observations of Comet Halley earlier this year indicated that the surface of its nucleus is almost black, suggesting the presence of carbon compounds and perhaps complex organic molecules. Asteroids are small rocky objects orbiting the sun between Mars and Jupiter. They also are believed to be remnants of early solar system material, some may be fragments of larger objects broken apart by collisions.

CRAF mission development and operations will be conducted by NASA's Jet Propulsion Laboratory, Pasadena, Calif. Ronald F. Draper is the project manager and Dr. Marcia M. Neugebauer, the project scientist. The CRAF program is managed by the Office of Space Science and Applications, NASA Headquarters.

New Space Astronomy Technique Developed to Study Celestial Bodies

A new space radio-astronomy technique, using an orbiting satellite to study celestial objects, was successfully tested by scientists at NASA's Jet Propulsion Laboratory, Pasadena, Calif.

An international team of scientists conducted experiments during July and August employing a new space technique called very long baseline interferometry (VLBI). They combined data from radio telescopes on the ground with data from an antenna on NASA's Tracking and Data Relay Satellite System (TDRSS) spacecraft, managed by NASA's Goddard Space Flight Center, Greenbelt, Md.

Investigators obtained better resolution of three quasars than is possible in ground-base radio studies at the same wavelength. Quasars, or quasi-stellar objects, are among the most distant objects known. The resolution obtained from the orbiting VLBI experiment was equivalent to that of a radio telescope with a size of 1.4 Earth diameters. The quasars studied are designated 1730-130, 1741-038 and 1510-089.

For the first time, a VLBI experiment used an orbiting satellite as one of its radio telescopes. Previously, scientists linked widely separated antennae on the ground with VLBI techniques to produce high-resolution radio astronomy studies of celestial objects.

Primarily ground observatories in the experiment were NASA's Deep Space Network 210-foot antenna in Australia and the Institute of Space and Astronautical Sciences' 64-meter antenna at Usuda, Japan. An 80-foot antenna at the Radio Research Laboratory in Kashima, Japan, also was used to check performance of the larger ground antenna.

Researchers believe the experiment's success demonstrates the feasibility of a proposed orbiting VLBI mission. That mission would use a satellite dedicated to radio-astronomy observations and would yield new data on many celestial phenomena, including the nature of galactic nuclei, the overall distance scale of the Universe and the formation of new stars.

The research team led by Gerald S. Levy and other JPL scientists included investigators from M.I.T.; the Haystack Observatory, Westford, Mass.; Bendix Field Engineering Corp., Columbia, Md.; the Spacecom/TRW/Bendix team, White Sands, N.M. and NASA's Goddard Space Flight Center, Greenbelt, Md.

Australian participants were from the Commonwealth Scientific and Industrial Research Organization and Australian National University's Mount Stromlo Observatory. Japanese experimenters were from the Institute of Space and Astronautical Science, the Nobeyama Radio Observatory and the Radio Research Laboratory.

NASA's portion of the VLBI experiment was jointly sponsored by the Office of Space Tracking and Data Systems and Office of Space Science and Applications.

Langley Employees Receive IR-100 Awards

A senior research scientist at NASA's Langley Research Center received an award in the 1986 IR-100 competition for developing one of the 100 most significant new technical products this year.

H. Douglas Garner, a senior research scientist in the Flight Management Division, developed a magnetic heading called a "Smart Compass."

Garner's device was developed to give the aircraft pilot an accurate digital reading of his magnetic heading and to serve as a magnetic heading reference for autopilots or other navigational aids. "The device offers the first simple, economical solution to a long-standing problem in aircraft navigation—that of providing the pilot with an accurate indication of his directional heading that is not disturbed by rough air or by turning maneuvers," Garner explained, "Its use obviates the need for the expensive, high-maintenance directional gyroscope normally installed to supplement the performance of the magnetic compass."

The compass uses a single-chip microcomputer to calculate the instantaneous magnetic heading of the aircraft from the outputs of a specially designed and extremely simple two-axis magnetometer. Garner says provisions are included for compensating or circumventing the usual magnetic compass errors, so that no directional gyroscope is required to supplement the compass readings.

Work at the Langley Research Center over the past few years has been directed toward the development of a low cost, compact, low maintenance instrument to replace the magnetic compass, directional gyro combination, which, though effective, is beset by typical gyroscope problems. The directional gyro is expensive, heavy, had a short operational life between overhauls, and requires periodic resetting by the pilot to correct for drift.

H. Douglas Garner, a senior research scientist in the Flight Management Division, holds a magnetic heading sensor called a "Smart Compass," which he developed to give the aircraft pilot an accurate digital reading of his magnetic heading and to serve as a magnetic heading reference for autopilots or other navigational aids.

According to Garner, conventional magnetic compasses suffer from a number of problems which make useful reading difficult or impossible in rough air and maneuvering flight. " 'The Smart Compass' avoids damping problems, since it employs no moving parts," explained Garner. "Its sensing element can be mounted remotely from the indicator to avoid errors due to local magnetic fields in the cockpit, and it includes circuitry for compensating 'northerly turning error,' which causes large errors in conventional compasses due to the influence of the vertical componment of the earth's magnetic field during banked turns."

Garner's device was placed on public display at the Experimental Aircraft Association's International Convention at Oshkosh, Wisc., in 1985, where it stimulated a great deal of interest from both pilots and builders.

Two engineers at Langley and the executive vice president of KineticsSystems Corporation also received awards in the 1986 IR-100 competition for developing one of the 100 most significant new technical products this year.

Daniel J. Crawford and Richard O. Staib of Newport News, Va., and Robert T. Cleary of Lockport, Ill., developed a data acquisition and control system for upgrading the Langley flight simulation facilities. Other applications of this system are expected in high energy physics studies and fusion research.

Crawford, Staib and Cleary developed the KineticsSystems Model 9450 Data Acquisition and Control System (DACS), which is an ultra high-speed distributed system for real-time data acquisition and control. The network conforms to an international high-speed network technology called Computer Automated Measurement and Control (CAMAC).

This system was developed by KineticSystems in conjunction with personnel at Langley to support the new distributed analog and digital interface between NASA's CYBER computers and 25 flight simulator sites. The data acquisition system which won the IR-100 award is a component of the larger Advanced Real-Time Simulation (ARTS) system, scheduled to begin service at Langley in 1987.

According to the developers, each network in the data acquisition system acquires flight control commands (input data) from piloted simulator cockpits and delivers the data to a large scientific computer. After the computation of the aircraft's dynamic response, the network delivers the output data to the various displays and other devices that cue the pilot(s). The developers describe this process as cyclical with periods as short as five milliseconds.

The effective time-critical rate for transporting the input and output data approaches 24 million information bits per second, using the new technology. According to the developers, this is three to ten times the effective rate that even the fastest competitive real-time networks can provide. The combination of high throughput fiberoptic links and dynamically switchable networks is unique to this newly-developed system.

Crawford and Staib of Langley's Analysis and Computation Division said they examined various alternatives for the new ARTS system, such as networks in use at aircraft manufacturers and other NASA centers, as well as in the computer industry. None of the other networks studied met the overall performance requirements for the new ARTS system.

Daniel J. Crawford, James R. Haasl and Richard O. Staib stand in front of the data acquisition and control system developed for upgrading Langley's flight simulation facilities. Crawford and Staib, along with Robert T. Cleary (not pictured), received awards for their development at the IR-100 awards luncheon September 25. Crawford and Staib are engineers in the Analysis and Computation Division; Cleary is the executive vice president of KineticsSystems Corporation, Lockport, Ill; and Haasl is the lead engineer from the Kennedy Space Center.

Two aerospace technologists at Langley and the director of safety for United Airlines also received awards in the competition.

Dr. Charles E. Knox and Dan D. Vicroy of Langley's Flight Management Division and Capt. David A. Simmons of Chicago, Ill., developed a simple, airborne flight-management descent algorithm.

The newly developed descent algorithm flight software can be used by all operators of jet powered aircraft for conducting fuel-conservative, 4-D (3-dimensional path plus time control) descents.

According to the inventors, the software provides open-loop, fuel-conservative descent guidance that will meet the time constraint for crossing a geometrical fix as designated by the air traffic control system. They said that no commercially available flight management systems are certified with the 4-D capability at the present time.

Pilots today use various rules of thumb to plan their descents. Some methods are very simple; others are more extensive. However, all methods require some computations, and therefore result in a higher mental workload for the pilot. The flight management descent algorithm was found by the pilots to be very useful and did not interfere with their normal flight duties.

The algorithm also will bring a more consistent nature to the descents from cruise, thereby improving the traffic flow into the terminal area. It has been estimated by one major airline that approximately $616,000 could be saved annually for each mile of improvement in planning where to start the descent.

The algorithm has been programmed into a small calculator. It can be operated in either a time mode or speed mode. The time mode was designed to aid the pilot in planning and executing a fuel-conservative descent to arrive at a time designated by the air trafic control system. The speed mode was designed for planning fuel-conservative descents when time is not a consideration

Capt. David A. Simmons, director of safety for United Airlines, holds the descent calculator used for planning fuel conservative descents. In the cockpit with Simmons are Dr. Charles E. Knox (left) and Dan D. Vicroy, aerospace technologists in Langley's Flight Management Division.

The developers said 4-D flight guidance will become a requirement for aircraft operators as time-based aircraft metering procedures are expanded by the Federal Aviation Administration. Time-based metering is now used at several busy terminal areas in the United States.

In the past 19 years of NASA's participation in the IR-100 competition, 70 NASA developments have been selected, contributing significantly to the recognition of NASA as one of this country's centers of technical excellence. Langley has earned 13 of NASA's 70 awards and the Lewis Research Center leads with 52 awards. NASA ranks third on the list of IR-100 award recipients.

The IR-100 winners were honored at an awards banquet at the Museum of Science and Industry in Chicago September 25. The banquet marked the beginning of a month-long exhibit of products to be viewed by scientists, engineers, educators and the general public.

The Future Spacesuit

Two items which often drive the design of space hardware—safety and cost effectiveness—are driving work at JSC to develop a new spacesuit for use on board the Space Station.

Conservative estimates indicate that there will be more EVAs on board the Space Station than is presently the case on the Space Shuttle. According to Mike Rouen of the Crew Systems and Thermal Division, this estimate was part of an early cost trade-off study to determine whether a new spacesuit was required for the Station. Rouen said that for the extensive EVA expected for such things as payloads and station maintenance, "it makes a lot of sense to develop a new spacesuit."

The suit being developed is a zero-prebreathe suit. Presently, astronauts aboard the Shuttle must go through a time consuming pre-breathe session to remove nitrogen from their bodies before undertaking EVA. The prebreathe session requires either having the EVA crewman breathe 100 percent oxygen for up to four hours prior to an EVA, or decreasing the Shuttle's cabin pressure to 10.2 psi for approximately 12 hours, and then breathe pure oxygen for 40 minutes. Either procedure is time consuming and interrupts other activities and experiments on the Shuttle. Just as importantly, the prebreathe session reduces the ability of the crew to respond to emergencies which require contingency EVA. Rouen said since the EVAs expected for the Station will be greater than those currently undertaken aboard the Shuttle, the inconvenience and cost associated with prebreathing is multiplied many fold.

"We expect up to 1,000 hours of EVA each year per suit once the Space Station is permanently manned. Since the prebreathe session uses up time on orbit—and the costs associated with an hour on orbit are mind boggling—it makes a lot of sense in the long run to develop a new suit which doesn't require prebreathing," Rouen said.

The cost trade-off studies undertaken by Rouen and his colleagues lead to the conclusion that zero-prebreathe suit (ZPS) is needed in the long run, but Rouen said the new suit will be phased into operation. He said any EVA required for initial Station construction will use present Shuttle suits, but he hopes a ZPS will be available for the Station when it becomes permanently manned. An alternate plan would use Shuttle suits for the first four to five years of operation of the Station.

Rouen said the development schedule of a ZPS is more flexible since it will only take some four years to develop, and it only takes 18 months to two years to make hardware components for the suit. An experimental ZPS being tested now prepares the flexibility in scheduling. The experimental suit demonstrates technology to support the final Space Station readiness schedule. Rouen said the Station Phase B contractors are also exploring new suit technology, with Rockwell subcontracting the work to Grumman, and McDonnell Douglas using Lockheed as a subcontractor.

The ZPS does not require prebreathing because it operates at a higher pressure and thus allows astronauts to move immediately into EVA without having to face decompression sickness. Decompression sickness, otherwise known as caisson disease or "the bends," arises when the body is exposed to a rapid or drastic changes in pressure. Body tissues contain dissolved gasses, principally nitrogen, in equilibrium with ambient pressures. When the outside pressure is dropped, nitrogen bubbles form in body tissues. If the pressure drops slowly in small increments, the bubbles are carried away by the blood to the lungs. If the pressure reduction is rapid or extensive, the gas bubbles become trapped in the body's tissues, giving rise to "the bends."

By operating at 8 psi, instead of the 4.3 psi at which the Shuttle suit operates, the pressure drop from 14.7 psi is not great enough to lead to decompression sickness. The higher suit pressures do impose some problems, however. For one, the suit must be more sturdy and must be carefully designed so it is not more difficult to move in.

"It's like bending a balloon, the more air in the balloon, the more difficult it is to flex it. But if you place rubber bands around the balloon, it's easier to flex," Joe Kosmo, also of the Crew and Thermal Systems Division, said. He added that one key aspect of the ZPS technology demonstrator suit is to find which joints are tough enough to withstand the higher operating pressures but don't excessively constrain the astronaut's motion.

Kosmos said a number of joints, ranging from toroidal convolute elbows to rolling convolute shoulders, have been developed to cope with this problem. He explained that these joints, which contain both fabric and metal rings, maintain flexibility because they maintain a constant volume of gas in the suit. As the top of a suit's joint is compressed, the joint is constructed so that the bottom expands. If the bottom did not expand, the pressure in the suit would increase, making further movement difficult. Kosmo said that one key technology for the ZPS is to develop a glove that will both handle the 8 psi pressure and still provide the flexibility and touch-sensitiveness that astronauts need.

Since the ZPS needs to be more sturdily constructed, it will probably weigh 50 pounds more than the Shuttle suit. The hard and semi-hard ZPS components will also occupy more volume than present Shuttle suits. These two factors will impose launch and storage constraints on the suit, but Kosmo believe these constraints will be more than compensated by the fact that individual joints, instead of entire arms or legs, may be replaced or stored in small areas. "These benefits should more than offset the initial individual weight and storage volume penalties," Kosmo said.

The technology demonstration phase of the ZPS is progressing well, and several different types of joints have been developed. The ZPS test suit developed uses a mixture of past, present and future technology as new arms and legs are tested on a Shuttle upper torso shell. These suit joints were developed using Apollo technology developed when NASA investigated a higher pressure suit for more lengthy stays on the lunar surface.

The job now facing Kosmo and others working on the suit is to determine which configuration of the ZPS is best. The final suit should allow freedom of motion with a minimum of effort. A number of tests are being conducted by co-operative education students to ensure this. One test used light emitting diodes placed on various locations of the suit, like the elbows and cameras in a darkened room to measure the reach envelope afforded by different joint designs. Another test used a medical device used for treating those with hand and upper arm disabilities. The device measures the torque and power a person applies to perform certain tasks. Finally, another device measures how the torque applied to a glove or joint varies with the angle of extension. "We want to develop a quantitative way to determine which joints and gloves are best," said Mariann Farquhar, a co-op student working on the ZPS study. The information gained from such a study will be used by more than the developers of the ZPS. "We expect satellite makers will use the data so that they won't make satellites which can't be worked on by astronauts," Kosmo said.

To perform these tests the suit has been pressurized up to 8 psi above the surrounding air pressure. Kosmo said they expect to have a suit ready for testing in the Weightless Environment Test Facility (WETF) by late 1987, and a suit rated for a pressure chamber will be available after that.

So a new suit is needed to handle the higher pressures associated with a ZPS, and a new life support system (LSS) is needed to meet Space

Station requirements as well. Rouen said the new suit will operate autonomously, although an umbilical may be used for EVA-intensive activities like satellite servicing. "The life support system for a suit is patterned after the space vehicle's characteristics. For example, on the Shuttle the fuel cells produce water, so we use this water to cool the astronaut by venting the water into space. But we don't want to have a cloud of steam around the Space Station, so we're looking into using either ice or wax for cooling on the new suit," Rouen said.

Rouen explained that blocks of ice or wax would be formed on the Station and then placed in a portable life support system. Water would then be circulated around the block to cool the astronaut. Rouen added that the system needed the flexibility to heat the astronaut because, "We've found that when an astronaut gets out of the Shuttle's payload bay, he often gets too cool, and we need to account for this in the new suit,"

The LSS must also provide the astronaut with oxygen and filter out trace gases. While the present Shuttle suit uses lithium hydroxide to filter out carbon dioxide, Rouen said they are looking into a solid amine and liquid absorbent system for the ZPS. Two requirements for the Station suit, that the suit's LSS be regenerable and servicable on orbit, are driving investigations into this area. To integrate the LSS with the ZPS, Rouen said they are investigating ways to provide a heads-up display with information from the LSS to the astronaut. With this, the astronaut can look up into his visor to check the status of his LSS instead of looking down at his chest as on the present Shuttle suit.

Finally, after an EVA, the suit will need servicing. This poses a unique challenge, and Rouen said the servicing area needed on the Space Station to service and check out the suit may be as difficult to build as the suit's LSS. Rouen said this will be a vital part of the new suit's system because present Shuttle suits are only rated to operate 21 hours before on-the-ground servicing. Although Rouen said this number is expected to double soon, it doesn't approach the 1,000 hours expected before on-the-ground servicing required for the Space Station. But this just once again leads to the conclusion that for the extensive EVA eventually planned for the permanently manned Space Station, a new space suit system must be developed.

From The Congressional Record

The following comments were provided by Senator Larry Pressler on NASA spinoffs

The U.S. Space program is at a crossroads. With the loss of the space shuttle *Challenger* in January and the destruction of the Delta rocket, Congress, NASA, and the public are conducting an intensive evaluation of the methods and goals of our Space Program. Such an inquiry is necessary to determine and correct the causes of those mishaps. I am confident that NASA can correct these problems, particularly under the leadership of its new Administrator, Dr. James Fletcher. I have no doubt that after this review is completed the Space Program will be stronger than ever, and we will be ready to continue our exploration of outer space. The benefits our country receives from the Space Program make it especially important that we continue to move forward in this area.

Those benefits are threefold: the expansion of our knowledge about space and the worlds around us; the contribution of space science and technology to our national defense; and the application of space technology to products and processes here on Earth. The first two topics have been covered in great detail many times before and do not need to be repeated now. I would rather discuss the civilian and commercial applications—or spinoffs—of space technology that have been developed during the long journey from the launch of Explorer 1 to the launch of the space shuttle.

The technology NASA has developed to meet its research goals and program needs represents an important national resource. It is a store of technical knowledge and innovation that can be applied to develop new products and processes for the benefit of our health and welfare, industrial productivity, and overall economic strength. At present, NASA has patented almost 4,000 aerospace inventions which are available for licensing for commercial development. In addition, an estimated 30,000 secondary applications of space science technology have emerged in the past 28 years.

These inventions and innovations cut across a variety of disciplines and economic sectors. A sampling of that list indicates the breadth of this technology transfer and includes the following fields: industrial productivity, environment, construction, public safety, energy, medical instrumentation, management systems, consumer products and computer applications.

Many of the innovative products now being used in the construction industry are direct spinoffs of materials NASA developed in order to reduce costs and protect its equipment. For example, in order to reduce maintenance costs for gantries and other structures at the Kennedy Space Center, a new coating was developed that would resist salt corrosion and protect the launch structure from the extremely high temperatures of rocket exhausts. This compound is now being used to protect bridges and commercial structures from the wear and tear associated with prolonged exposure to the elements.

In a similar vein, NASA needed to develop a new fabric for astronaut space suits which had to be durable and inflammable, yet thin, light, and flexible. In conjunction with a major manufacturing company, NASA developed a material, woven from glass fiber yarn, which was coated with Teflon and tailored into space suits. A heavier adaptation of that fabric is now being used as a canopy covering shopping centers and sports stadiums—including the University of South Dakota's DakotaDome at Vermillion. The material's unique qualities reduce the need for artificial lighting and help lower cooling costs.

Consumers will also recognize a number of everyday products which apply space science developments generated by the Space Program, including scratch resistant sunglasses and lightweight sports equipment.

NASA innovations have also been applied to public safety. Application of the technology used to develop high capacity rocket engine pumps, lightweight material, and compact packaging, has resulted in a high-capacity firefighting pump the city of Miami uses for shipboard and harbor fires.

During the Apollo Program, NASA found a need to develop special high intensity lights to simulate the effect of sunlight on the spacecraft and its occupants. This technology was the foundation for a line of products now used by law enforcement agencies for search and surveillance activities. Other space science safety developments include cockpit voice synthesizers which warn airline pilots of impending danger, and fire resistant materials used in a variety of products.

Perhaps the most spectacular advances resulting from the U.S. Space program have occurred in the field of health and medicine. Technologies adapted from both the manned and unmanned programs have been converted into lifesaving mechanisms that are used by people in all stages of life. A process that monitors astronauts' vital functions from the ground has been adapted to help diagnose and treat patients who experience difficulty walking due to birth defects, disease, or injury. Spinoffs from the miniturization required in space flight include the heart pacemaker—which prevent thousands of deaths annually—and tiny pumps that continuously release medication inside the body. Finally, the space imagery techniques developed and refined for Earth observation satellites such as Landsat—which has played such an important part in the EROS Data Center in South Dakota—are being applied to enhance sophisticated diagnostic x-rays that would otherwise be difficult, if not impossible, to decipher.

I have taken the time to describe just a few of the many benefits our society has realized from the Space Program to make the point that we derive much more from space exploration than merely increased knowledge of the stars above. Not only do we increase our basic knowledge of the world around us and the worlds beyond, we also develop new products and processes that can be applied in all aspects of our life here on Earth. I hope that all of us in Congress and the public at large will keep this in mind as we continue to discuss the future direction of our Space Program. I am fully confident that the National Aeronautics and Space Administration, under the able direction of Dr. Fletcher, will continue its exemplary work in the development and application of technological innovations.

Robots of the Future?

A self-guided robot, which is an early developmental model for future Space Station robots, is being tested in the Tracking Techniques Branch, Tracking and Communications Division, at the Johnson Space Center, Houston, Tx. and also was displayed at the Engineering Exposition July 30 and 31.

The Tracking Techniques Branch is working on robotic servicing as part of an overall robotics development effort headed by NASA's Goddard Space Flight Center. The Branch is developing tracking and vision systems for use by robots on board the Shuttle as well as the Space Station.

NASA plans to use robots on Space Station for a variety of routine 'outside" jobs. Robots will be used for inspection and maintenance on Space Station, to assemble Space Station payloads such as free-flying platforms or large telescopes, or to retrieve and repair satellites.

Robots also will be used for remote controlled jobs with astronauts giving commands and the robot performing the tasks. This will allow complicated work to be done at remote locations, such as a polar-orbiting platform, without the astronaut's presence.

A robot uses a McDonnell Douglas developed sensor on top of a JSC developed base to follow Anne Marie Ching. The robot uses a video sensor to follow Ching by tracking the contrasting black square on Ching's white lab coat.

Space Station tasks will require robots to track moving objects, and the sensor demonstration robot has that capability. The robot is a tracking system on a mobile platform which uses long and shortrange television cameras as "eyes." It is approximately five feet tall and three feet wide and weighs approximately 450 pounds.

Robots sent into space will be more compact, lighter and slimmer. They will be proportionately similar to humans, so they can use the same tools and equipment astronauts use. For example, robots and astronauts will wear the same size manned maneuvering units for extravehicular activities. That way, NASA will not have to design special equipment for the robots.

NASA and You

Combining Work and Family

Working Parent, there are ways to lessen the load you are carrying! Here are some suggestions:

- Learn to recognize your own individual signs of stress (extra irritability, headaches, overeating). Try to slow down for a day or two. Identify what is causing the stress (work, relationship, kids, home, self?), and make what changes you can.
- Think about your goals and expectations and the goals and expectations others have for you. Are they realistic and reachable? If not, try to change them.
- Monitor (and limit) the number of responsibilities you take on at one time. For example. If your home life is pressured, try to limit social or work commitments until things settle down.
- Also, analyze your day and its most stressful times. Limit the number of activities during these times.
- If you feel guilty having your children in child care, try to remember that there is no one correct way to parent and you are not the only person who can meet your child's needs. Your importance will not be diminished by sharing your parenting role.
- Talk to your family about what you are feeling. Partners and children are often willing to help when they understand what is going on with you. The same is true for co-workers and bosses. Give them an opportunity to help and support you.

Are you a working parent, trying to juggle your family, job, home, relationship, and your own needs? Do you often feel tired and overburdened, split in many directions, disorganized, and guilty? If so, you are not alone. Just about everyone who is working and taking care of a family feels this way at one time or another. No matter how organized you are, stress is an inevitable part of life, and can be broken down into four areas:

- **Practical**—Time and energy limits make it impossible to do all the things you want and feel you should do at home. There are so many details in your lives and lives of your family that stress results from trying to manage them all and work too.
- **Work**—Every job has its own demands (busy

times, difficult tasks, request for extra involvement) which creates stress. If these demands come at a time when there are family demands, even more stress results.

- **Interpersonal**—You often do not have much time for socializing. Friends or family may not understand your dilemma, and feelings of isolation and stress can occur. Intimate relationships may also suffer when both partners work and have little time to nurture their relationship.
- **Self**—Most working parents (particularly women) feel some guilt about the need or choice to work and be away from their families. These feelings cause stress and often result in working parents trying to do everything perfectly and blaming themselves when they can't be "superpeople."

by Susan Zweig, Ames

National Space Transportation System Manifest

- The following manifest is a projection of anticipated flights of each Shuttle orbiter with specific major payload assignments. Secondary payloads will be assigned on a space-available basis at a later date.
- The President's recent decision on space commercialization is reflected in this manifest. NASA shall no longer provide launch services for commercial and foreign payloads subject to exceptions for payloads that: (1) are Shuttle-unique; or (2) have national security or foreign policy implications. This manifest is being released with the expectation that current customers who are not included will voluntarily seek launch opportunities elsewhere. NASA intends to invite these customers to meet with NASA officials to discuss their transition.
- Because of the two-year downtime and the reduced flight rate resulting from the loss of Challenger, a substantial backlog of payloads will exist for some time. This backlog will be reduced by utilizing the STS and ELV missions, military and civil.
- The generic priorities for payload assignments were:
  - — National Security
  - — STS operational capability (TDRS), dedicated science payloads
  - — Other science, and foreign and commercial
- Other factors which influence the manifest include:
  - — Difference in capability of specific orbiters
  - — Turnaround of airborne support equipment
  - — Planetary launch windows
  - — The post-accident reassessment of Shuttle flight rate capability
  - — The cancellation of the Shuttle/Centaur upper stage
  - — The standdown of the Vandenberg Shuttle launch complex until 1992
- The combined effect of these factors means that flight of most payloads are delayed more than the two-year downtime with some payloads being delayed for three or more years. Such large delays are primarily the result of manifesting constraints and the intense competition of many payloads for the limited flight opportunities.
- As is shown in the manifest, the resumption of Shuttle flight operations is projected for the launch of the Discovery on February 18, 1988. The first several flights are spaced to allow adequate time to perform a detailed analysis and assessment of the flight performance of the redesigned solid rocket motor. The first mission payload will be a NASA Tracking, Data and Relay Satellite (TDRS). Another TDRS will be flown on the fourth mission, thereby establishing the TDRS network vital to space operations. Other early flights will carry important national security payloads and a major science payload—the Hubble Space Telescope and Astro-1 (Astrophysics Science).
- The second twelve months of operations continue NASA's efforts to reduce the backlog of national security payloads and to support Magellan (Venus Radar Mapper) and a second planetary mission. This period also includes the first opportunity to fly a DOD Global Positioning System navigation satellite (GPS NAVSTAR). This 12 months will also see the launch of a major NASA Life Sciences Spacelab mission, as well as Astro 1 (Astrophysics Science) and the Gamma Ray Observatory.
- The third year reflects the continuing effort to reduce the backlog of national security payloads, the flight of several science missions, another planetary mission, and the accommodation of additional GPS NAVSTAR satellites. Beyond the first 3 years, flights are projected by quarter only. The planetary missions referred to in the manifest include Ulysses, Galileo, and Mars Observer.

Flight Schedule for 1988

Flight Number	Date Orbiter	Incl Alt	Crew Duration	Payload	Carrier
26	02/18/88 Discovery	28.5 160	5 4	TDRS-C	IUS
27	05/26/88 Atlantis	0.0 0	0 0	Department of Defense	
28	07/28/88 Columbia	0.0 0	0 0	Department of Defense	
29	09/22/88 Discovery	28.5 160	5 4	TDRS-D	IUS
30	11/17/88 Atlantis	28.5 320	5 7	HST	

Flight Schedule for 1989

Flight Number	Date Orbiter	Incl Alt	Crew Duration	Payload	Carrier
31	01/19/89 Columbia	28.5 190	7 7	Astro-1	IG+2P
32	03/02/89 Discovery	0.0 0	0 0	Department of Defense	
33	04/25/89 Atlantis	28.5 110	5 4	Magellan	IUS
34	06/02/89 Discovery	0.0 0	0 0	DOD Spacelab	LM
35	06/21/89 Columbia	28.5 160	5 7	GPS-1 GPS-2 MSL-3	PAM-D2 PAM-D2 MPESS
36	07/20/89 Atlantis	0.0 0	0 0	Department of Defense	
37	09/01/89 Discovery	0.0 0	0 0	Department of Defense	
38	09/21/89 Columbia	28.5 160	5 5	GPS-3 GPS-4 MSL-4	PAM-D2 PAM-D2 MPESS
39	11/01/89 Atlantis	28.5 110	5 4	Planetary Oppty	
40	12/07/89 Discovery	57.0 160	7 7	SLS-1	LM

Flight Schedule for 1990

Flight Number	Date Orbiter	Incl Alt	Crew Duration	Payload	Carrier
41	01/18/90 Columbia	28.5 200	5 4	GRO	
42	02/15/90 Atlantis	0.0 0	0 0	Department of Defense	
43	04/20/90 Discovery	28.5 160	7 7	IML-1	LM
44	05/04/90 Columbia	28.5 160	5 7	GPS-5 Pathfinder EOS-1 Share	PAM-D2
45	05/31/90 Atlantis	0.0 0	0 0	Department of Defense	
46	07/12/90 Discovery	0.0 0	0 0	Department of Defense	
47	07/26/90 Columbia	28.5 160	5 7	GPS-6 Skynet-4 MSL-5	PAM-D2 PAM-D2 MPESS
48	08/31/90 Atlantis	0.0 0	0 0	Department of Defense	
49	10/05/90 Discovery	28.5 110	5 4	Planetary Oppty	
50	10/25/90 Columbia	28.5 160	5 7	GPS-7 INSAT-1D TSS-1	PAM-D2 PAM-D
51	11/15/90 Atlantis	28.5 200	5 7	LDEF Retrieval Syncom IV-5	

Flight Schedule for 1991
(Partial Schedule)

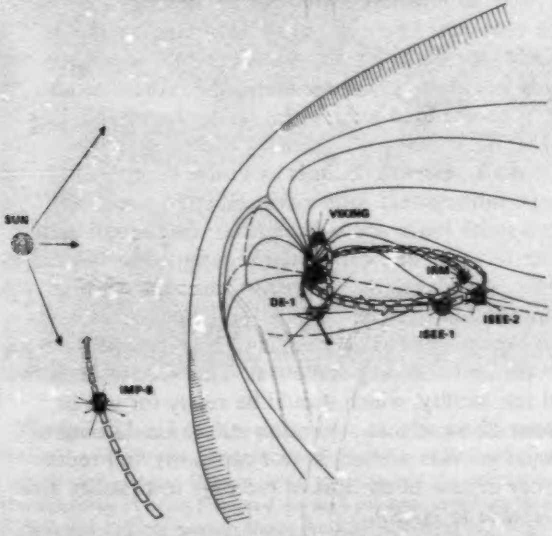
Flight Number	Date Orbiter	Incl Alt	Crew Duration	Payload	Carrier
52	01/17/91 Discovery	57.0 160	7 7	Atlas-1 COFS-1	1G+2P Pallet
53	02/14/91 Columbia	28.5 160	5 7	GPS-8 GPS-9 MSL-6 SSBUV-1	PAM-D2 PAM-D2 MPESS
54	03/01/91 OV105	0.0 0	0 0	Department of Defense	
55	04/04/91 Atlantis	28.5 160	5 7	GPS-10 SKYNET-4 EURECA	PAM-D2 PAM-D2

Did You Know?

NASA spacecraft launched in 1973, 1977, and 1981 have played central roles in an intensive international campaign to increase man's understanding of the plasma processes by which solar variations yield auroras and other effects in the Earth's environment. The campaign, named PROMIS (Polar Region and Outer Magnetosphere International Study), involved a data acquisition phase (March-June, 1986) and a subsequent data analysis phase.

PROMIS capitalized on the unusually favorable configuration of spacecraft in, and beyond, the Earth's magnetosphere (that vast and complex region of space threaded by geomagnetic field lines). The NASA contributions to this spacecraft constellation consist of IMP-8 (Interplanetary Monitoring Platform), ISEE-1 and -2 (International Sun Earth Explorer), and DE-1 (Dynamic Explorer). The additional spacecraft, Viking, IRM (Ion Release Module, part of the AMPTE mission), and ISEE-2 are from Sweden, Germany, and ESA (European Space Agency), respectively. All these spacecraft are instrumented to measure electric and magnetic fields, plasmas, and energetic charged particles. In addition, the DE and Viking spacecraft carry imaging systems by which auroras are imaged from above.

PROMIS SPACECRAFT CONFIGURATION



This constellation of spacecraft measures variations of the solar wind as it impinges on the magnetosphere (IMP-8), the resultant energy and plasma accumulation and release in the magnetotail (ISEE-1, ISEE-2, IRM), and the deposition and dissipation of this energy by auroal and other processes deep within the magnetosphere (DE, Viking).

The PROMIS effort was conceived by Dr. Ed Hones of the Los Alamos Scientific Laboratory. Much of the detailed planning, led by the Project Scientists of the NASA missions, Drs. Joe King, Keith Ogilvie, and Bob Hoffman, all of Goddard, involved the identification of several periods of several hours each when the relevant spacecraft were in particularly favorable locations. Much support was provided by the National Space Science Data Center's Satellite Situation Center (NSSDC's SSC) and "Sardi" Parthasarathy during this and later phases. (See figure 2.) Support from NASA Headquarters, especially Drs. Shelby Tilford and Stan Shawhan of the Office of Space Science and Applications and from Mr. William Bastedo and Mr. James Costrell of the Office of Space Tracking and Data Systems, resulted in an adjustment of the ground telemetry acquisition stations' priorities, so that most of the requested concurrent coverage (many hundreds of hours) was obtained. Excellent support was received from Goddard's Mission Operations and Data Systems Directorate.

The data analysis process will have two phases. First, a panel of scientists representing the various spacecraft involved and related ground-based data sources will identify those intervals characterized by both good data coverage and the occurrence of interesting geophysical activity. (Time intervals which are either too quiet or too complex are not optimal for yielding new scientific results.) Next, an intensive analysis of the many data sets available for the selected events will be pursued by many NASA, other U.S., and international scientists. A significant tool in this analysis will be the NSSDC Coordinated Data Analysis Workshop (CDAW) software package.

PROMIS is an exciting campaign which seizes on a target of opportunity and which is expected to lead to significant advances in solar terrestrial physics at minimal cost. PROMIS will build on the multipoint measurement approach initiated in the ISEE and DE programs in understanding the complex solar wind/magnetosphere coupling in the dynamic geospace environment. As such, PROMIS is a pathfinder for the International Solar—Terrestrial Physics (ISTP) Program proposed for the early 1990's.

Mr. Dale D. Myers was appointed by the President as Deputy Administrator of NASA. Mr. Myers succeeds Dr. William R. Graham who left NASA to become Director of the White House Office of Science and Technology Policy.

Myers previously served as an at-large member to the NASA Advisory Council, the organization created to provide advice and counsel to NASA top management on aeronautics and space programs. From 1984 to 1986, he was a private consultant in Aerospace and Energy. From 1979 to 1984, he served as President and Chief Operating Officer of the Jacobs Engineering Group, Inc., in Pasadena.

Myers was Under Secretary of the U.S. Department of Energy from 1977-1979. From 1974-1977 he was Vice-President, Rockwell International and President, North American Aircraft Group, El Segundo, California. He was the Associate Administrator for Manned Space Flight at NASA from 1970-1974. From 1969-1970 Mr. Myers served as Vice-President/Program Manager, Space Shuttle Program, Rockwell International. He was Vice-President and Program Manager, Apollo Command/Service Module Program, North American-Rockwell from 1964-1969.

Myers was born in Kansas City, Missouri, on January 8, 1922. He graduated from the University of Washington, Seattle in 1943 with a B.S. degree in Aeronautical Engineering and received an honorary doctorate from Whitworth College in 1970.

He is married to the former Marjorie Williams of Seattle and they have two children.

Astronaut Frederick D. Gregory, Col., USAF, was named Chief of the Operational Safety Branch, Safety Division, in the Office of Safety, Reliability, Maintainability and Quality Assurance, NASA Headquarters, effective Oct. 14, 1986.

The purpose of this new position is to provide a senior safety manager for agency-wide oversight of NASA space and aeronautic programs operations and research and development and test facilities activities which affect both ground and flight operational safety. Gregory will participate with industry, the Department of Defense and other government agencies in developing policy and criteria to assure safety of personnel, equipment and mission for complex ground and flight operations.

NASA employees and contractors attended the grand opening of the Goddard Space Flight Center Visitor Center's new exhibit area on Monday, October 27, 1986.

The new exhibit area reflects the changes that have taken place in the space program since the Visitor Center was opened 10 years ago.

Designed for children of all ages, the new area will house various interactive exhibits which simulate living in space, working on the space shuttle, and performing scientific and commercial experiments on the space station.

Among other attractions, visitors will be able to sit in a mock-up of a Manned Maneuvering Unit—used for propelling astronauts during their excursions outside the shuttle—and simulate the operation of the vehicle, sign up to have their name carried into space, or sit in a gyro chair and feel what it's like to navigate and control a spacecraft.

The centerpiece of the new hall will be an eight-screen visual presentation highlighting a window into space.

After an intensive study, NASA determined that the redesigned Space Shuttle Solid Rocket Motor (SRM) will be test fired in a horizontal attitude. This test attitude best simulates the critical conditions on the field joint which failed during the STS-51-L mission.

NASA also will conduct extensive component tests, full-segment joint environmental simulation tests (with loads applied) and full-scale motor static tests to verify and certify the redesigned motor for flight. Also being considered at this time is the construction of a second horizontal test stand with the capability of simulating launch and flight loads on the motor during static test. This second horizontal test facility, which should be ready for use in about 12 months at a location still to be determined, would provide additional test capability and redundancy in case of the loss of the only test facility now available to NASA.

The Presidential Commission investigating the STS 51-L accident recommended that NASA consider the vertical attitude for the motor firings and duplicate the actual flight conditions as closely as possible. It is NASA's belief that testing in the horizontal attitude is the most demanding test of the redesigned joint for pressure and flight-induced loads and thus best satisfies the Commission's intent.

These findings were reviewed within NASA's technical community, with the Shuttle management's formal review system, an SRM design overview committee composed of NASA and industry experts, and the U.S. Air Force team which is responsible for returning the Titan launch vehicle to flight status. They also were presented to the independent SRM design review panel of experts established under the auspices of the National Research Council.

NASA believes that the test plan being implemented will provide the correct basis for flight verification of the redesigned SRM.

The Rotor Systems Research Aircraft that will be used to test the X-Wing concept developed by NASA and DARPA arrived at NASA's Ames-Dryden Flight Research Facility via the Super Guppy aircraft on September 25, 1986. Flight tests, scheduled to begin later this fall at Ames-Dryden, are a major step in the development of an X-Wing vehicle which could provide both the vertical lift characteristics of helicopters and the high subsonic speed capabilities of fixed-wing aircraft. This photograph, taken in the Edwards AFB Weight and Balance hangar, shows the RSRA/X-Wing just following removal from the Super Guppy. The RXRA/X-Wing program is a joint NASA/Defense Advanced Research Projects Agency (DARPA) effort. The flight investigation program is managed by NASA's Ames Research Center, Moffett Field, California, with flight test at Ames-Dryden. Sikorsky Aircraft, the manufacturer, will conduct the flight program under the direction of Ames.

NASA's Outstanding Handicapped Federal Employee of the Year-1986 is Mr. Lowell D. (Butch) Fair, Jr., who maintains the Automatic Data Processing (ADP) Equipment Inventory for all of NASA's Kennedy Space Center. He must collect information from many different sources at the Space Center and verify its accuracy with relevant procurement and planning documents. Obtaining this information from quasi-autonomous contractors is a challenge that requires initiative and perseverance. Mr. Fair must prepare a list of the changes found in the Center's inventory for transmission to NASA Headquarters and subsequent inclusion in the General Services Administration government-wide data base. The information he supplies is consistently accurate and timely. He interfaces with a large cross-section of NASA and contractor personnel in an unfailingly pleasant manner. He has shown considerable ingenuity in developing innovative methods for performing his task. He received a Superior Achievement Award in 1982 for his efforts in automating his work with the APD Equipment Inventory.

He has combined his personal interest in microcomputers with his work by staying on the leading edge of the advances in Office Automation. He recently completed a project, "Voice Activated Computer Utilization," which demonstrated that voice control is well-suited for the input of highly complex commands, voluminous data, and applications where keyboard entry is awkward. This effort was published in the Kennedy Space Center's "Research and Technology 1985 Annual Report."

Mr. Fair has received numerous agency and community recognition awards and is one of the founding members of Space Coast Association of Physically Handicapped, whose objective is to help and encourage those with physical limitations.

Dr. Robert Brown, Director, Education Affairs Division, NASA Headquarters is pictured with some of the exhibits displayed during the Future Work Force Conference.

"Will the United States remain a leader in productivity and technical development or lag behind other nations?" "Will our children be prepared to meet the technical demands of the future?" "How can the business community help our schools develop skills and motivate young people to excel in math and in science in order to increase the technical and scientific pool of talent?" These were some of the questions addressed by a gathering of approximately 125 representatives at a conference entitled, "The Future Work Force," sponsored by NASA's Office of Productivity Programs and the Educational Affairs Division, NASA Headquarters, held at Goddard Space Flight Center, Greenbelt, Md. September 10-11, 1986.

Some important innovations, tested programs and hard facts were candidly shared by conference participants. Many of those participants believe that the synergism of industry and education partnerships has, does, and will favorably impact the quality of our future work force.

Innovative approaches to enhance the technological curriculum of the future work force were unveiled at the 2-day conference.

As a precursor to this conference NASA met with 20 companies and three of our "Teachers in Space" in April 1986 to consider joint initiatives to impact the nation's school systems. While Goddard was the first Center to host a future work force conference, it is hoped that future conferences will be held at other Centers. NASA fills a valuable niche by bringing education and industry groups together and fostering their entrepreneurial cooperation.

Contractor News

NASA awarded two contracts for high-speed, civil air transport studies, one to **Boeing Commercial Airplane Company,** Seattle, and one to **McDonnell-Douglas Corporation,** Long Beach, Calif. The total Boeing contract is valued at approximately $4.5 million, the total McDonnell-Douglas contract at $4.4 million.

The two-year contracts will be cost shared with NASA on a 50-50 basis. The contracts contain options to extend the effort and performance period which may result in a potential final cost of approximately $9 million for each contract.

The studies seek to make use of expected technological advances from work on the National Aero-Space Plane program and from continued research on high-speed aircraft in general to satisfy two major objectives. The first objective is to identify the most promising concepts for future long-range, high-speed, civil transport aircraft. The second is to provide information needed to guide NASA planning of technology development.

The two contractors will conduct the work in three phases. The first phase will consist of an initial assessment of potential vehicle concepts, of relevant non-vehicle technologies and of commercial value, ie., economics, scheduling and marketing. The second phase will produce a prioritized list of vehicle concepts. The final phase will focus on one or two of the more promising vehicle concepts per contract.

This work requires an understanding of the economics, flight speeds, size, range, fuel type and technology levels required for the proposed vehicles to become successful major elements in the international air transportation system.

The companies are to take into consideration that continued international growth and economic development into the next century is expected to create a significant market for high-speed, long-range air transportation. Further, that the need to conduct business in areas such as the Pacific basin will place emphasis on minimizing trip time and increasing productivity. Either a hypersonic transport, based in large part on aerospace plane technology, or an advanced supersonic cruise airplane that incorporates emerging technologies could prove to be an attractive and economically competitive vehicle for this market.

The work will provide a fresh look at a wide variety of technical options. While this study can benefit from the lessons learned in past studies of higher-speed transports, it cannot be treated as an extension of previous work.

The work will be peformed at the companies' home locations and will be monitored by NASA's Langley Research Center, Hampton, Va.

NASA's Ames Research Center, Mountain View, Calif., awarded a $9.4 million contract to **Pratt & Whitney,** West Palm Beach, Fla., for research, technology and developmental activities that could lead to a demonstrator supersonic research aircraft capable of short takeoff and vertical landing (STOVL) in the early 1990's.

A key factor in a STOVL aircraft program is development and integration of the propulsion system into the airframe. A propulsion system demonstration in the 1990's would use a derivative of an advanced technology engine, such as the PW5000 engine currently being developed by Pratt & Whitney for the U.S. Air Force.

The study will initially evaluate the integration of an advanced derivative PW5000 engine into four candidate propulsion system concepts. The four concepts under consideration are vectored thrust, ejector augmentor, remote augmented lift system and hybrid tandem fan.

This ground-based research program is a cooperative effort between NASA, the Defense Advanced Research Projects Agency and the U.S. Air Force.

The 3-year contract began in October.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

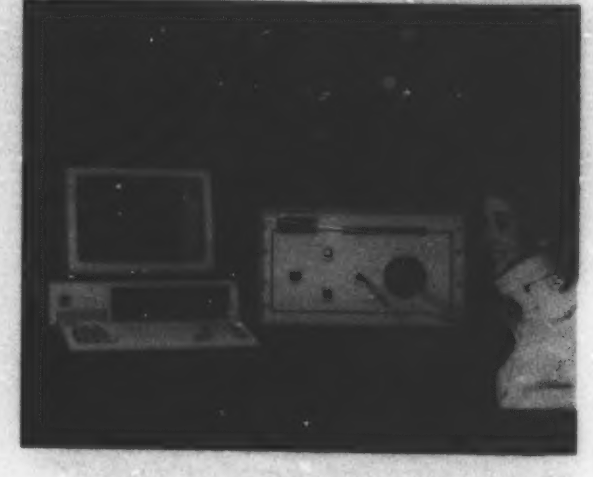
Blood Pressure Control

In the photo, the model is demonstrating use of the Baro-Cuff, a system typical of that developed for a cardiovascular study of weightless astronauts, it may help people who suffer from congestive heart failure or diabetes. The astronaut experiment was conceived by Veterans Administration Dr. Dwain L. Eckberg; the equipment was developed by Engineering Development Laboratory (EDL), Newport News, Virginia for use on the Spacelab 4 mission as part of a broader Space Shuttle Life Science Experiments program. EDL then conducted an internal research and development program to reduce the complexity of the system and adapt it to Earth-based medical research applications.

During space flight, astronauts experience greater than usual blood pressure and heart rate instability, which sometimes induces postflight lightheadedness or even momonetary blackout, temporary symptoms that gradually disappear, suggesting that weightlessness may impair the body's normal blood pressure controls. In the Spacelab-4 investigation, the Baro-Cuff will be used to study "resetting" of blood pressure reflex controls. A silicone rubber chamber strapped to the neck, the Baro-Cuff will stimulate the carotid arteries by electronically-controlled application of pressure or suction.

Patients with congestive heart failure, chronic diabetes mellitus and other conditions also experience abnormal blood pressure reflex controls. As a medical research tool, the Baro-Cuff will be used to study blood pressure controls and the results of stimulation in such patients.

In 1985, EDL delivered its first Model E-2000 Baro-Cuff System to the Veterans Administration Hospital in Gainesville, Florida, where it is being used in kidney function research. The company has also developed and sold specialized configurations for use by U.S. medical colleges in clinical investigations and is marketing the system to international researchers in the field of cardiovascular physiology.



* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.